JPRS-CEA-84-090

26 October 1984

# China Report

## ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT -- 32

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# CHINA REPORT

## ECONOMIC AFFAIRS

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## CONTENTS

OIL AND GAS

NATIONAL POLICY

## HEAVIER STATE INVESTMENT INVIGORATES ENERGY SECTOR

Beijing XINHUA in English 1314 GMT 22 Sep 84

[Text] Beijing, 22 Sep (XINHUA)--China's steady rise in energy output is due to more state investment in this priority item for the country's modernization.

This was stated by Yu Yingzhou, senior engineer of the Energy Department of the State Economic Commission, in an interview with XINHUA on the eve of the 35th anniversary of the People's Republic of China.

Some 40 percent of this year's capital construction investment, 5 percent more than in 1983, has gone for energy and communications.

There are 46 energy projects listed among this year's key projects: 14 coal fields, 26 power projects and 6 oil fields.

The first 8 months of this year saw continued progress in the country's energy output, Yu Yingzhou said. Daily crude oil output in August averaged 315,000 tons, hitting an all-time high.

Coal mines opened last year in China had a combined production capacity of 18.52 million tons, oil wells drilled and put into production had an aggregate capacity of 8.1 million tons, and power stations added had a total generating capacity of 4,460 megawatts. Coal mines now under construction have a total production capacity of 130 million tons.

In 1983, China dug 715 million tons of coal, pumped out 106 million tons of crude oil and 12.2 billion cubic meters of natural gas, and produced 86.4 billion kwh of hydroelectric power, all topping the targets set for 1985, the last year of the country's Sixth Five-Year Plan 1981-1985).

Energy consumption for 1981-83 per million yuan of output value dropped by 4.9 percent a year as against the planned target of 2.6 percent for 1981-85.

Efforts will be intensified to retool Chinese enterprises, upgrade their technology and techniques, and improve the economic structure and management.

But, energy supply still falls far short of demand, Yu Yingzhou said. He said that about 20 percent of the country's machinery remains idle due to a shortage

of energy. Efficiency of energy utilization is still low, he said. Output value per ton of standard coal is far behind that of Japan, the United States or the Soviet Union.

China's coal, oil and other resources will be developed with foreign cooperation so as to accelerate the country's modernization, Yu Yingzhou said, quoting repeated statements by Vice-Premier Li Peng, who is in charge of energy.

China signed 23 contracts with consortia composed of 31 oil companies from nine countries on joint exploration and development of offshore oil deposits between 1980 and 1983.

The first and second offshore oilfields are expected to start trial production in the coming two years in the Bohai Sea and the Beibu Gulf of the South China Sea. The second round of international bidding for Sino-foreign joint oil exploration and development is to start soon.

China will also inrease its cooperation with foreign firms for onshore oil exploration, production and refining through introduction of advanced technology and key equipment.

Coal mine projects China is now discussing with foreign companies will have an aggregate production capacity of some 100 million tons, and contracts for some of the projects have already been initialled or signed.

Yu Yingzhou pointed out that China's potential energy resources include 770 billion tons of known coal reserves and coal is the primary source of energy. China ranks first in the world in exploitable waterpower sources coming to 380,000 megawatts.

The country has 5.45 million square kilometers of oil-and-gas-bearing sedimentary rock area including the 1.3 million square kilometers of offshore continental shelf within a water depth of 200 meters.

China plans to produce 1.2 billion tons of standard coal by the year 2000, twice the 1980 figure to provide adequate energy to reach the goal of quadrupling the 1980 industrial and agricultural output value by the end of this century.

CSO: 4010/6

POWER NETWORK

## GROWTH OF POWER SECTOR IN PAST 35 YEARS RECAPPED

HK101500 Beijing RENMIN RIBAO in Chinese 7 Sep 84 p 1

["Facts and Figures" column edited form the data published by the Ministry of Water Resources and Electric Power: "Power Industry, the Vanguard, Is Advancing at an Accelerated Rate"--passages within slantlines published in boldface]

[Text] Since the 3d Plenary Session of the 11th CPC Central Committee, the development of the power industry has been given top priority. In 1983 the national output of electricity reached 351,400 million kilowatt-hours and the installed capacity reached 76.44 million kilowatts, an increase of 80.7 and 40.3 times, respectively, over 1949. Progressively increasing at an average annual rate of 13.8 percent, the output of electricity ranked 6th in the world, up from 25th in 1949, and the installed capacity ranked 8th, up from 21st in 1949. The national electricity output of 4 and 1/2 days is now equal to the electricity output of a whole year in the early post-liberation period.

/Thermal Power Has Been Energetically Developed/ In 1949 the national installed capacity of thermal power plants was only 1.69 million kilowatts, with an electricity output of 3,600 million kilowatt-hours. In 1983 the installed capacity of thermal power plants reached 52.28 kilowatts, with an electricity output of 265,100 million kilowatt-hours, an increase of 30 and 73 times, respectively, over 1949. At present there are not only big power bases in northeastern China in Beijing, Tianjin and Tangshan, and in eastern China, but also a large number of large and medium-sized power stations in the developing industrial cities such as Wuhan, Zhengzhou, Chongqing, Baotou, Taiyuan, Lanzhou, Xian, Kunming and Urumqi.

/Numerous Kinds of Electrical Energy Have Been Developed/ China has also developed and utilized numerous kinds of energy resources in light of the local conditions, and thus satisfactorily solved the electricity problem in the vast rural areas, the fishing and pastoral areas, and the outlying areas inhabited by the minority nationalities. In 1983 the installed capacity of small power stations reached 8.5 million kilowatts. Now more than 80 percent of villages throughout the country have access to electricity.

Yangbajing, in Xizang, is the largest geothermal power station in our country. Three of its generating units, with an installed capacity of 4,000 kilowatts, have gone into operation. The Jiangxia hydropower station in Zhejiang Province

is the largest power station of its kind in China. It has yielded notable results since its first generating unit, with an installed capacity of 500 kilowatts, went into operation.

/Construction of Nuclear Power Stations Has Been Started/ At present, in addition to the 300,000-kilowatt Qinshan nuclear power station in Zhejiang which we designed and developed, the construction of the Guangdong nuclear power station, which utilizes foreign funds and technology and which has an installed capacity of 1.8 million kilowatts, has also been started. China will also build large nuclear power plants in eastern and northeastern China, where there is a shortage of energy.

/Tremendous Successes Have Been Attained in the Construction of High-Tension Transmission Lines/ We have developed from the construction of 35 kilovolt transmission lines in the early post-liberation period to the construction of 110, 220, 330 and even 500 kilovolt superhigh-tension transmission lines. We now have 315,000 kilometers of transmission lines of 35 kilovolts or above, an increase of about 50 times over the early post-liberation period. The capacity of transformer equipment at a tension of 110 kilovolts or above has increased from 900,000 kilovolt-amperes when the PRC was founded in 1949 to 116 million kilovolt-amperes, an increase of 129 times.

CSO: 4013/240

POWER NETWORK

## YUNNAN'S POWER PRODUCTION TRACED OVER 35-YEAR PERIOD

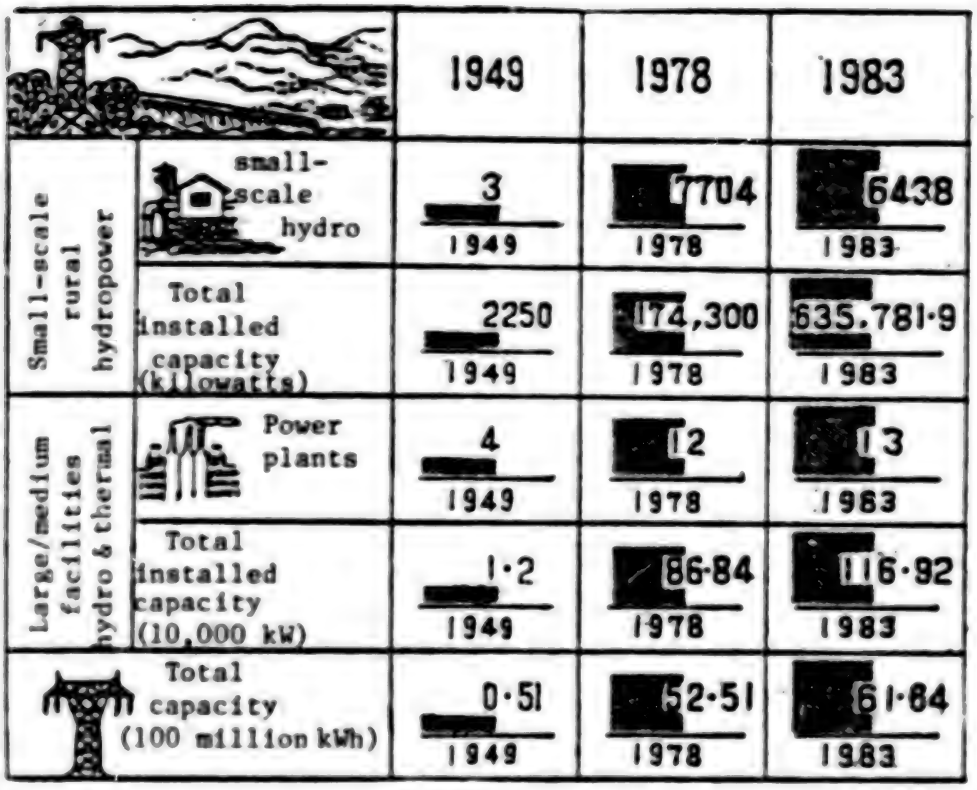
Kunming YUNNAN RIBAO in Chinese 13 Aug 84 p 1

[Excerpts] Since the founding of the nation, Yunnan's electric power industry has expanded by leaps and bounds. Today, the daily peak power production is 171.41 million kilowatt-hours, half of the total 1949 output.

Before Liberation, the total installed capacity in Yunnan Province was only 13,000 kilowatts, enough for influential families living in Kunming and some public lighting. Most of the people didn't even know what electricity was. In 1955, the province undertook large-scale development of the electric power industry. Large numbers of electric power construction personnel arrived in the province to work on the construction of new power plants. They built 13 large and medium hydroelectric power stations and thermal power plants including Pupingcun, Yangzonghai, Xuanwei, and Yili He. The installed capacity was over 1.1 million kilowatts. Along with small-scale power facilities, this basically satisfied the growing demand for power by industry and the people. After the Third Plenum of the 11th Party Congress came the Xi'er He Second Cascade power station, the Xunjiansi power plant, the stepped-up Chuxiong power transmission line, and other major projects. Also completed were the southern and central Yunnan power grids. In this manner, a backbone 110,000-Volt power transmission network some 2,300 kilometers long was established throughout the province. Transmission lines of 35,000 Volts and below densely covered the cities and the countryside alike, forming a provincial network centered around Kunming, combining the previously built 13 hydropower stations and thermal power plants, regulating the power supply and assuring a stable source of good quality power.

In these 35 years, Yunnan's rural areas have made use of abundant hydraulic and coal resources to operate small-scale power facilities; power stations may be found in many of the villages and hamlets in all counties in the province. As of the end of last year, 128 counties had set up power facilities and more than 90 percent of the villages had built power stations; there were more than 6,400 small-scale power plants (stations) throughout the province, an average of 50 or so per county.

In order to meet the soaring demands for industrial and agricultural production, Yunnan is in the process of building more power facilities. Today the 600,000 kW Xiaolongtan No 2 and Lubuge projects are being built, Pupingcun is being rebuilt, and Baishui is being surveyed and planned. In a year or two, Yunnan's generating capacity will be much larger than it is today.


1949
1978
1983
Small-scale rural hydropower
small-scale hydro
3
7704
6438
1949
1978
1983
Total installed capacity (kilowatts)
2250
174,300
635.781·9
1949
1978
1983
Large/medium facilities hydro & thermal
Power plants
4
12
13
1949
1978
1983
Total installed capacity (10,000 kW)
1·2
86·84
116·92
1949
1978
1983
Total capacity (100 million kWh)
0·51
52·51
61·64
1949
1978
1983

CSO: 4013/236

POWER NETWORK

## PROJECT TO CONNECT SHAANXI-GANSU-QINGHAI, NINGXIA GRIDS APPROVED

Yinchuan NINGXIA RIBAO in Chinese 17 Aug 84 p 1

[Text] The project to connect the Shaanxi-Gansu-Qinghai power grid to that of Ningxia has recently been approved by the State Planning Commission and work is to begin in the near future.

The 330-kilovolt transmission line connecting the Shaanxi-Gansu-Qinghai grid to Ningxia begins in Haishiwan in Gansu Province and passes through Baiyin and Jingyuan to Qingtongxia for a total length of 425 kilometers, 210 kilometers of which represents the section between Jingyuan, in Gansu, and Qingtongxia. First in the plan for this year and next is the construction of the high-tension transmission line between Jingyuan and the transformer station in Gucheng, Zhongning County, for an investment of 23 million yuan. After the project to connect the Shaanxi-Gansu-Qinghai power grid and Ningxia's grid has been completed, it will play a major role in regulating the hydroelectric and thermal power of the four-province region, upgrade the reliability of the power supply of our region, and promote the development of the great northwest. Today, the early-phase planning of the Jing (yuan)-Qing (tongxia) section of the 330,000-Volt transmission line to connect Shaanxi, Gansu, Qinghai and Ningxia has been examined and approved by the Northwest Electric Power Administration Bureau and the involved departments are now at work preparing for the initial phase.

CSO: 4013/3

HYDROPOWER

## PROGRESS IN HYDROPOWER IN PAST 35 YEARS HIGHLIGHTED

HK301219 Beijing RENMIN RIBAO in Chinese 28 Aug 84 p 1

["Facts and Figures" Column Article Contributed by the General Company of Water Conservancy and Hydropower: "Hydropower Generated in 3 Days Is Equal to That in 1 Year"]

[Text] In the last 35 years, the hydropower construction of our country has developed tremendously. In the country, a total installed capacity of over 24 million kilowatts has been built, and the generated energy in 1983 reached 86.4 billion kilowatt-hours, increases of 147 times and 122 times respectively when compared with 1949. The hydropower generated in 3 days today equals that in 1 year in 1949. Regarding the installed capacity of hydropower of our country, it has risen from the 25th position in 1949 to 6th in the world.

In the last 35 years, the prospecting, surveying and designing personnel have successively carried out three comprehensive and large-scale investigations on water energy resources, covering a total of more than 5,800 large and small rivers, and have mapped out water energy development plans for various rivers such as the Huang He and the Hongshui He. Up to the end of June this year, 21 large hydropower stations each with a production capacity of 250,000 kilowatts and above, including those at Gezhouba, Liujiaxia and Wujiangdu, over 130 medium-sized hydropower stations, and over 80,000 small stations had been built. Twenty-five percent of the electricity consumed in cities and in rural areas in the country is supplied by hydroelectric power. As for the 13 provinces and regions of Hubei, Hunan, Guangdong, Guangxi, Sichuan, Yunnan, Guizhou, Xizang, Gansu, Ningxia, Zhejiang, Fujian and Jiangxi, the proportion of installed capacity of hydropower stands at over 50 percent. Of the 2,000-odd counties in the country, small hydropower stations have been installed in 1,574 counties.

In order to build these hydropower stations, the hydropower builders of our country have dug out and removed a total of more than 535 million cubic meters of earth and stone, and have poured a total of 55.46 million cubic meters of concrete. The quantity of these engineering projects is equal to an earth and stone wall 1 meter in height and 1 meter in width, stretching 13.7 times around the equator of the earth and a concrete wall stretching 1.4 times around the equator of the earth.

In conformity with the needs of the building of the four modernizations and the characteristics of rich resources of our water energy, the electric power industry of our country has gradually placed its key points on the construction of hydropower, and is doing its best to exploit the water energy resources. In the coming period, efforts will be concentrated to develop hydropower at the upper reaches of the Huang He, Hongshui He, and the mainstream and tributaries of the upper and middle reaches of the Chang Jiang. At present, projects being carried out include the second phase of the Gezhouba project, Baishan, Longyangxia, and others, covering 21 large and medium-sized hydropower stations, with an installed capacity of over 12 million kilowatts.

CSO: 4013/240

## DEVELOPMENT OF TIBET'S HYDRAULIC RESOURCES DISCUSSED

Beijing SHUILI SHUIDIAN JISHU [WATER RESOURCES AND HYDROPOWER ENGINEERING] in Chinese No 7, 20 Jul 84, pp 1-10

[Excerpts] The rivers in Tibet hold enormous hydraulic resources. Preliminary data shows that the natural hydraulic reserves based on the average flow of many years is about 200 million kilowatts, which represent 30 percent of the natural hydraulic reserves of rivers in China. Of this, the natural hydraulic reserves of rivers in the inland drainage system are extremely small or under 1 percent of Tibet's total, while reserves of the outflowing drainage region is over 99 percent of Tibet's total.

The geographical distribution of Tibet's natural hydraulic reserves is as follows: the southeastern part of Tibet has the most, about 60 percent of the total; the three rivers in the eastern part of Tibet about 15 percent; the southern part of Tibet about 24 percent; and the inland drainage system in the northern part of Tibet a mere 0.2 percent.

See Table 1 for the natural hydraulic reserves of the main rivers in Tibet. Among the rivers, the Yarlung Zangbo has the most natural hydraulic reserves. Its main river and five tributaries hold 100 million kilowatts, next only to the Chang Jiang and second among the rivers of China. The Yarlung Zangbo has a drainage area less than one-seventh of the Chang Jiang's and is only one-third as long. As a result, the hydraulic reserves of unit length and unit drainage area of the Yarlung Zangbo is far greater than the Chang Jiang's and is the highest among the rivers of China.

The flow direction of the upper and lower reaches of the Yarlung Zangbo is generally from west to east. The lower reaches turn sharply to the northeast near Zaipai, but in the lower reaches of the Palung Zangbo it turns south abruptly and continues to flow south-westward, forming the world-famous great bend. To the left of the great bend is the Jailabolei Peak with an elevation of 7,151 meters and to its right is the Nanjiabawa Peak with an elevation of 7,756 meters. The two peaks stand facing each other with the river flowing down sharply and the precipices setting each other off, forming the world's deepest gorge. The gorge is over 200 meters in length, the height of water is over 2,250 meters and the average surface gradient is about 9 percent. The average flow for many years is 1,914 cubic meters per second and the natural hydraulic reserve is about 42,250,000 kilowatts.

The runoff of rivers in Tibet is not steady. Variation between wet and dry seasons is so considerable that the time distribution of hydraulic resources is uneven. Although large rivers do not cut off during dry seasons, the flow is far less than in flood seasons. Therefore if we build run-of-river hydropower stations, power generation will be much less in the dry than the flood seasons. Most medium-sized and small rivers will cut off in the dry season and the problem will be even more acute. Therefore regulation of run-of-rivers in Tibet is a necessary measure in the rational utilization of hydraulic resources.

Conditions of Hydropower Generation

Before liberation, Tibet had only one small hydropower station with an installed capacity of 120 kilowatts. Later, it ceased to operate because of an accident so that before liberation there was not a single electric lamp in Tibet. After liberation, hydropower generation in Tibet was considerable. In order to resolve the problem of electric power use in Lhasa, in 1958 the Najin hydropower station was constructed on the Lhasa He and subsequently the Qamdu, Lhasa Xijiao, Tang He, Woka hydropower stations with an installed capacity of 3,000 to 6,400 kilowatts were built. See Table 2 for the technical targets of the main hydropower stations that have already been constructed. By the end of 1981 the installed capacity of hydropower stations was about 78,000 kilowatts.

Developing Hydropower Is an Effective Way To Overcome the Energy Shortage

The existing hydropower stations in Tibet are far from able to satisfy the demand for electric power. Because of power shortages, industrial production has been limited and agricultural sideline products and processing can only rely on manual labor, thus creating shortage of labor in Tibet. The soil in Tibet is poor and it lacks organic fertilizer. Urban and rural residents in Tibet generally use cattle dung, turf, bush fallow, and wood as fuel. Such fuels constitute 5.6 percent of the daily energy used by the people of Lhasa. If things continue this way soil fertility will decline further, soil erosion will intensify and ultimately the ecological balance will be affected. Therefore, solving the problem of energy resources has become a major concern of the people of all nationalities in Tibet.

Analyzing the information we currently have, Tibet is short of coal, gas, and oil, and conditions for developing thermal power are poor. Although geothermal, solar and wind energy have great potentials, at present we are still unable to turn them into primary energy resources. Developing hydro-electric power is therefore the effective way to overcome the shortage of energy in Tibet.

In developing hydro-electric power we must suit measures to local conditions and carry it out with planning. In view of the characteristics that Tibet's economic development had a late start, its conditions in communications are poor, its industrial power consumption is low, its everyday power consumption is high and its cities and towns are few and dispersed, hydropower stations should be constructed according to the principle of dispersion and supplying power to immediate areas.

Table 1. Values of Characteristics of Major Rivers in Tibet

| Name of River | JINSHA JIANG | LANCANG JIANG | NU JIANG | ZAYO QU | DANLONG QU | YARLUNG ZANGBO JIANG | XIBAXA QU | BAOLUOLI HE (KAMEN HE) | PONG QU | LANGQEN ZANGBO | SENGGE ZANGBO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item | | | | | | | | | | | |
| Drainage area (square kilometers) | 23,060 | 38,300 | 102,500 | 17,827 | 11,270 | 240,480 | 26,664 | 10,790 | 25,307 | 22,760 | 27,450 |
| Length (kilometers) | 509 | 509 | 1,393 | 295 | 178 | 2,057 | 406 | 236 | 376 | 309 | 430 |
| Drop (meters) | 1,059 | 1,263 | 3,697 | 4,785 | 4,064 | 5,435 | 5,090 | 4,240 | 3,325 | 2,400 | 1,264 |
| Average gradient ratio (per 1,000) | 2.08 | 2.48 | 2.65 | 16.20 | 22.89 | 2.64 | 12.54 | 17.97 | 8.84 | 7.77 | 2.94 |
| Annual runoff (per 100 million cubic meters) | 75.0 | 114.9 | 358.8 | 252.3 | 259.2 | 1,395.4 | 293.3 | 129.5 | 49.2 | 9.1 | 6.9 |
| Average annual flow capacity (cubic meter per second) | 238 | 364 | 1.138 | 800 | 822 | 4.425 | 930 | 411 | 156 | 28.9 | 22.0 |
| Natural hydraulic reserves (10,000 kilowatts) | 374.9 | 729.2 | 2,009.6 | 680 | 967.0 | 7,911.6 | 1,046.4 | 158.4 | 257.0 | 23.8 | 10.4 |

NOTE: All data are from within Tibet.

Table 2. Technical Targets of Major Hydropower Stations in Tibet

| Name of Power Station | Location | Installed Capacity (Kilowatts) | Annual Output (10,000 Kilowatt-hours) | Construction Began | Power Generation Began |
|---|---|---|---|---|---|
| Najin | Lhasa He | 7,500 | 4,554 | 1958 | 1960 |
| Qamdo | Ngom Qu He tributary of Lancang Jiang | 6,400 | 5,000 | 1965 | Aug 1967 |
| Woka | Woka He tributary of Yarlung Zangbo Jiang | 6,400 | 3,819 | Jun 1974 | Oct 1978 |
| Lhasa west cascade | Doilung Qu tributary of Lhasa He | 3,440 | | Jul 1971 | 1973 |
| No 606 | Xueba He tributary of Nyang Qu | 3,750 | 2,440 | Mar 1972 | Mar 1974 |
| Bayi | Bayi Gou downstream of Nyang Qu | 3,100 | 1,329 | | |

9586
CSO: 4013/208

## MEASURES TO REDUCE HYDROPOWER CONSTRUCTION COST, TIME DISCUSSED

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 7, 12 Jul 84 pp 3-6

[Article by Zhang Daofu [1728 6670 1381]: "Water Resources and Hydropower Development Corporation Formulates Short- and Long-Term Measures To Shorten Construction Time and Lower Cost"]

[Text] In earnestly implementing Comrade Hu Yaobang's instructions on "Lowering construction cost, selecting the best program and shortening construction time," the Water Resources and Hydropower Development Corporation used the Yinluan project as an example, and on the problem of using relatively small capital to build a considerable number hydropower stations it has mobilized all the comrades in the system of water resources and hydropower to study and discuss in earnest, find out where we lag behind, advance their views and make proposals. The broad masses of the people unanimously believe that reform is necessary if China's hydropower construction is to suit the needs of national economic growth and to catch up with advanced world levels. Combined with the realities of China's hydropower construction, reform must emphasize three points: eradicate the old ways and vigorously pursue technical progress; break the old regulations and practice and vigorously pursue modern management; and eradicate the force of habit and vigorously pursue the use of new people. On this basis the Water Resources and Hydropower Development Corporation has formulated short- and long-term measures.

### I. Nine Things To Stress in the Next Two Years

#### 1. Reform of the construction management system

For a long time water resources and hydropower construction units followed the form of self-management. Construction units were both first and second parties, and for quite a long time they even led design units, lacked economization, did not have competition, and took a short-cut by eating out of the "big pot" which did not favor reducing construction cost and time. In 1983 we conducted experiments with the "three selfs" (self-construction and designing, self-equipping and self-construction) and one contract (economic system of contract responsibilities) at the Hongshi hydropower station in Jilin, with 9 engineering bureaus dividing up the contract for various construction tasks. The big flow process is estimated to save 20 million yuan in capital (about 8 percent of the total investment). Construction time can be reduced by 1 year and a medium-sized hydropower station (of 200,000 kilowatts)

can be built in 3 years. The Yatanshui hydropower station which began construction this year is also prepared to adopt Hongshi's form to organize construction. At the same time, experimental points for the large contract are carried out at Gezhouba, Jinshuitan and other hydropower stations which will be gradually carried out among all hydropower projects throughout the country in the next 2 years.

In order to further carry forward reform of construction enterprises, turn the situation of sole operation around and drive construction enterprises toward the production-operation type, by combining with the use of foreign capital at the beginning of this year we have conducted international and domestic open bidding for the Lubuge hydropower station in Yunnan. At the same time, we have selected Shitang hydropower station in Zhejiang for open bidding in China and for selecting the best construction units. According to preliminary estimate, through competitive bidding and by promoting a common effort to tap potentialities among design, construction, equipment manufacturing and production management departments, capital in the original budgetary estimate can be lowered by about 20 percent. Within 1 or 2 years we must expand the scope of experimental points and finalize bid management measures that will suit the characteristics of China's hydropower in order to bring about a gradual transition to contracts signed by the state and bidding by enterprises.

2. Revision of design rules and standards

China has made outstanding achievements in designing the Liujiaxia, Wujiangdu and Gezhouba hydropower stations, but on the whole our levels still lag behind those in foreign countries. For one thing, rules and standards tend to be conservative, which is a chief symbol of our lag. Because comprehensive revision of rules and standards requires considerable time, this year we plan to first revise certain aspects within the scope of design of buttress dams whose directions are relatively definite and for which there are advanced examples at home and abroad, altogether 7 or 8 aspects such as anti-sliding stability design, treatment of uplifting pressure and special load combination. As a further example, the volume of excavation for dam foundations in China is determined by the degree of weathering and generally it tends to be high; whereas foreign countries determine the scope of excavation according to bedrock strength and demand on stability, supplemented by measures of foundation treatment so that the volume of excavation is greatly reduced. Therefore, we must revise such outdated rules.

3. Adopt advanced measures in survey and design

In their general survey of water energy resources, exploitation and prospecting of watersheds and hydroelectric engineering design, foreign countries have made extensive use of advanced equipment such as those for aerial survey, geological photography, remote sensing and physical survey, computers and automatic drawing instruments. Canada uses helicopters for prospecting. Within 2 years the LaGrande river program as well as its second-stage prospecting design (5,328,000 kilowatts) were completed and construction began in the third year. Prospecting and overall design tasks for the Itaipu hydropower station in Brazil took 4 years to complete. A design office with a staff of several hundred can undertake the design tasks of several tens of large- and

medium-sized projects within a year. In comparison, our work in prospecting and designing is basically in the form of handicraft and the period for prospecting and designing a large-sized power station would generally take more than 10 years. We must therefore do our best in the program. In the next two years, all design institutes must popularize the use of microcomputers, use high capacity computers in a planned way, gradually improve prospecting methods and pursue standardization and seriation of design.

4. Vigorously pursue progress in construction techniques

The absolute majority of hydropower stations under construction in China uses various types of concrete dams and we have continued to use the traditional construction methods of the Hoover Dam in the United States of the 1930s. Strict temperature control, high consumption of forms, the treatment of joints and low utilization rate of machinery have become serious obstacles to shortening construction and lowering cost. In recent years, Europe, the United States and Japan have experimented the use of new dam construction techniques with rolled concrete. The United States used this dam construction method to build the 52-meter high concrete gravity dam at (Wigg Creek) in 1980. Construction time was less than a year and cement usage was 47.4 kilograms per cubic meter, with the unit price of the concrete at 30 percent of that of dams in general. In the last 2 years we have conducted experimental construction with rolled concrete at the Tongjiezi hydropower station in Sichuan and the Shaxikou hydropower station in Fujian. We have also decided to use this dam construction method at the 60-meter high concrete cofferdam of the Yantan hydropower station which begins construction this year and to vigorously popularize it after experience is obtained.

In constructing concrete dams we must continue to popularize the two blends (powdered coal ash, additive) and the three forms (composite steel forms, concrete prefab forms, sliding forms) and other achievements in technological innovation, reduce cement usage and economize on timber. The Wujiangdu hydropower station used the "two blends" to save 160,000 metric tons of cement and the rate of economization was 20 percent. The Dahua hydropower station uses the "two blend" method and the cement usage of every cubic meter of concrete has been reduced to 162 kilograms, but compared to the 135 kilograms of the Itaipu hydropower station in Brazil the difference is still considerable. Recently we have decided to make vigorous use of blending with powdered coal ash in appropriate places in the Gezhouba project. In 1984 we plan to save 100,000 metric tons of cement by using concrete with the "two blends," use steel forms with an area as much as 60 percent, use sliding forms wherever it is feasible, and expand the scope of usage of concrete prefab forms so that the use of concrete prefab forms for openings and corridors within the dam will reach 90 percent.

In order to suit the needs of constructing the three Gorges project on the Chang Jiang, we plan to expand the Jingmen Cement Plant and rebuild the Jingmen Thermal Power Plant to experiment with the production of powdered coal ash cement.

At the same time we must intensify our research on the treatment of thick coverage layer and complex foundation and on the construction of great

spanning underground rooms, and continue to popularize such techniques as presplit blasting, clear-surface blasting, spray anchoring in underground engineering and prestressed anchor cable reinforcement. Moreover, we must popularize the use of microcomputers. At present, among the hydropower construction units in China only the concrete blending building at the Gezhouba is using microcomputers and has realized automatic control. In the next 2 to 3 years we must gradually apply automatic control and enterprise management to major construction equipment and installations with microcomputers in a planned way.

5. Emphasize projects under construction

"A long journey begins with the first step." Giving emphasis to projects under construction by every possible means in order to begin production ahead of time is an effective measure to increase economic results. Projects under construction should follow the example of the Yinluan project by strengthening unified leadership over the construction site, making rational and prompt allocation of equipment and materials, and safeguarding completion on schedule this year for the production of 800,000 kilowatts. The Yinluan Rutang project should be open to water half a year earlier in the first half of 1985 in accordance with rational time limit set by the state. The Hongshi and Taipingwan hydropower stations must begin power generation one year ahead of time. For the Gezhouba phase two, Longyangxia, Taipingwan, Hongshi, Yuzixi, Xi'erhe and Jinshuitan projects which plan to generate power, we must stress the implementation of technical measures to safeguard production on schedule or ahead of time. At present the Gezhouba project generates power by cofferdam retainment of water. On the prerequisite of guaranteeing safety in construction, last year the water level of the Gezhouba was raised by 0.5 meter which generates an additional 100 million kilowatt-hours. This year we must continue to study positive measures in order to alleviate the demand of power consumption in central China.

6. Formulate policies related to the development of hydropower

The development of hydropower concerns a broad area with long-term effects so that we must formulate a series of correct policies in order to open up a path for it. Policies which have already begun and must continue to complete are as follows:

(1) Measures for immigration and land requisition. Considerable losses in flooding and immigration are inevitable in developing hydropower, and with China's conditions of having little space and a large population the problem of flooding and immigration appears to be even more acute. Analyzing the figures of immigration and land requisition required per unit kilowatt and comparing projects under construction with completed projects, flooded land is 1:5 and immigration is 1:3, but the expense for immigration has grown from the period of the First Five-year Plan by more than 10 folds, and the trend of increase will continue. The "Regulations on land requisition for state construction" provide that measures for immigration and land requisition in water resources and hydropower projects will be drawn up by the Ministry for Water Conservancy and Power and submitted to the state for approval. We have adhered to the basic spirit of the "Regulations," formulated measures by combining

with the actual conditions of water conservancy and hydropower projects and have sought the opinions of concerned units. The measures will be submitted to the state for approval within the year.

(2) Measures for distributing benefits of power stations. In constructing hydropower stations, local areas must bear certain losses but should also receive the necessary benefits in order to mobilize local enthusiasm. The problem of distributing benefits must be properly resolved particularly with hydropower stations constructed on rivers that cross provinces. We have already drawn up the measures for distributing benefits on the basis of the area of flooded land, the number of immigrants and the degree of contribution to the power stations. It is hoped that they will have the support of concerned departments and that they will be submitted to the state for approval within the year.

(3) Fund raising measures for the construction of power stations. The development of power stations requires substantial funds. As the state is financially limited we need to raise funds from various quarters. First, we can utilize foreign capital. For instance the Lubuge, Shaxikou and Tianshengqiao projects have respectively made use of foreign capital. In the future, use of foreign capital and advanced technology to speed up China's hydropower construction can be considered in projects which meet the conditions. Second, we can adopt the measures of fund raising for power supply jointly between central and local authorities. At present, the Baozhusi hydropower station in Sichuan, the Wan'an hydropower station in Jiangxi and other stations have adopted the method of sharing the expenses for immigration and land requisition between central and local authorities and of local use by contracts. This should be continued and we can gradually expand the scope of sharing of expenses as investment on power stations in shares with extra dividends.

7. Revise the channels of funds and the depreciation system of purchase expense for construction machinery

For a long time the purchase expense for water conservancy and hydropower construction machinery have come out of project capital. Construction machinery is used without compensation and construction units have neither economic responsibilities nor a strict system of control over expense rate. The disadvantages of this "supply system" outweigh its advantages. According to statistics, construction equipment expense forms about 12 percent of project capital. However, the utilization rate of equipment and installations is merely around 45 percent (compared to 84 percent abroad) and productivity is merely 50 percent of those with similar capacities abroad. Therefore, in order to economize on capital investment and safeguard rational use of construction machinery we need a steady source of fund. We plan to start by strengthening management and reforming the system of depreciation and sources of fund. In the future we plan to resolve the purchase expense of construction machinery by depreciation fund and technical installation expense. The rate of depreciation must be increased and the depreciation fund must be used for its specified purpose only. Purchases for the purpose of renewal and transformation should be covered by the depreciation fund and those for expanded reproduction should be covered by technical installation expense.

Technical installation expense should be changed from the current "supply system" to funding according to contract tasks. For large equipment for special use in special projects or when specially needed which cannot be covered by technical installation expense, they can be itemized with estimates and submitted for approval. It is estimated that after these reforms are carried out equipment purchase expense can be reduced by about 6 to 8 percent of the project capital.

8. Resolutely carry out continuous terraced development

Carrying out continuous terraced development over a "rich ore" river section will favor speeding up the pace of designing, the link up of various projects and operations, the transfer of worker contingents and the flow process as well as building the construction base. The Fourth Bureau of Water Conservancy and Power spent 17 years (including 3 years of suspension) to build the Liujiaxia, Yanguoxia and Bapanxia hydropower stations along a 100-meter river section of the Huanghe above Lanzhou with an installed capacity of 1,757,000 kilowatts and an investment of 923 million yuan. Each station took an average of 5 years to build and the capital for unit kilowatt was 525 yuan. From the beginning of power generation to 1983 a total of 91,000,000,000 kilowatt-hours were generated with an accumulated output value of 6,000,000,000 yuan (based on constant price) which is a precedent of success. Practice has proved that continuous terraced development is a macro policy-decision to lower cost and shorten construction time.

Based on the demand of continuous terraced development we plan to connect Dahua (400,000 kilowatts) with upstream Yatan (1,100,000 kilowatts, construction started this year) in Guangxi, Jinshuitan (200,000 kilowatts) with downstream Shitang (78,000 kilowatts) in Zhejiang, Dadongjiang (500,000 kilowatts) with downstream Xiaodongjiang (55,000 kilowatts) in Hunan, Ankang (800,000 kilowatts) and downstream Xunyang (300,000 kilowatts) in Shaanxi, and Taipingwan (192,000 [?] kilowatts) with Jinkeng (85,000 kilowatts) and Gaoling (50,000 kilowatts) in Liaoning. This will give play to the macro benefits of hydropower and we hope to get the support of concerned departments.

9. Provide leadership group that suits the demands of the four modernizations

The key to reform is the use of people and we must pay particular attention to the new generation around the age of 40. In using people we must suit jobs to their special training as much as possible and pay attention to the work ability and special skills in other areas displayed by cadres. It is very difficult to use new people at present. We must liberate our mind, promote those who dare to bring forth new ideas, dare to be responsible and can initiate new situations, and we must speedily place the worthy and able in responsible positions and make the best use of people.

II. Eight Long-Term Measures

Hydropower construction must continue to develop and reform must constantly intensify. In the long run we still need to seek new ways in certain things on the basis of investigation and research. There are eight specific and tentative ideas:

1. Do preliminary work conscientiously

Preliminary work is the basis of macro policy-decision in hydropower construction; failure of a policy-decision may lead to the greatest waste. We plan to use about  years to complete the supplementary program of the 7 major rivers, and 2 to 5 years to finish the hydropower program of important rivers (or river sections). We will strive to design storage capacity of 50,000,000 kilowatts by the end of 1985 which will include a preliminary design of 30,000,000 kilowatts and a feasibility study of 20,000,000 kilowatts, storage capacity of 70,000,000 kilowatts by the end of 1987 which will include a preliminary storage of 40,000 kilowatts and a feasibility study of 30,000,000 kilowatts in order to provide conditions for the state to select the best program.

2. Vigorously popularize dams built with local materials

Along with the development of construction machinery and techniques, the superiority of dams built with local materials has become increasingly clear. This shortens construction time and lowers cost because dams built with local materials can fully utilize local earth and stone materials and economize on large quantities of cement. According to statistics, the proportion of dams in foreign countries built with local materials among dams that are over 100 meters high has increased from 1 to 3 in the 1960s to almost 2 to 3 today. With the exception of the Lubuge hydropower station in Yunnan, all our dams under construction are concrete dams. Therefore, we must vigorously popularize dams built with local materials in the future and make it one of our major technical policies.

3. Formulate a policy of shared investment

Hydropower construction has the benefits of comprehensive utilization in flood prevention, power generation, shipping, water supply and irrigation. Foreign countries have a policy of shared investment but so far China still ties up the investment of comprehensive utilization on hydropower construction. Not only does this increase the investment on hydropower construction but is unfavorable to the economic accounting of concerned departments. It even causes large amounts of state funds to lie idle or go to waste. This is a manifestation of "eating out of the big pot" and we urgently need to formulate measures of shared investment.

4. Improve the quality of enterprises

Although we have made preliminary regulation of leadership groups, some of their ages tend to be high, their level of education tends to be low and they lack knowledge of modern management. The political, cultural and technical quality of young workers are also low. Technical cadres are few in number, their division of work is overly refined and their scope of knowledge is narrow. Construction machinery is relatively old. Enterprises are poor in their administrative and management ability, ability to get information feedback, competitiveness, ability to meet contingencies and ability to develop. Therefore, on the basis of investigation and research, we must continue to regulate and build leadership groups, strengthen their ideological and professional building;

consolidate and develop the achievements of enterprise readjustment and do a good job in establishing enterprises; strengthen intellectual development and do a good job in training staff workers; and earnestly strengthen various basic tasks and positively carry out modern management. At the same time we must stress study and reform of the management system of hydropower construction in order to suit the development of hydropower construction.

(5) Change the composition of workers

A considerable number of workers are used in hydropower construction. At present each engineering bureau has around 10,000 people who are unitary regular workers. For some jobs which are not technically complicated we can possibly use the broad human resources of local rural areas. Moreover, China has a tradition of mass peasant participation in hydropower construction. Therefore, in order to study and change the composition of construction workers we must turn the unitary regular workers into a multi-level structure of combined regular, contract and temporary workers. This is an important measure to lower cost, shorten construction time and reduce the burden on enterprises.

6. Reduce the social burden of enterprises

Hydropower construction is usually conducted in remote mountains and gorges and the circumstances of enterprises running a society are very noticeable. The No 12 Bureau is an example. In over 30 years it has built 8 to 9 hydropower stations, including Xin'an Jiang, with an installed capacity of more than 1 million kilowatts and an output value of 10,000,000,000 yuan so that it has made contributions to hydropower construction. At present the entire bureau has 2,000 retired workers, 1,000 workers with silicosis, almost 1,000 workers who have suffered injury on the job, sickness or disability, and 600 persons in rear hospitals and schools. In other words, 6,500 people work to feed 11,000 people and the social burden of enterpises is very heavy. We are prepared to investigate and study and to find ways to reduce the social burden of enterprises.

7. Actively develop specialized construction contingents

At present, hydropower construction in China is basically carried out by comprehensive construction contingents. They cover almost all types of work from civil construction to the installation of equipment and from construction preparation to trial transmission and production. According to the construction program it is not necessary to have so many types of work in construction at the same time. This results in uneven workload and low labor productivity. Such a form of organization of construction contingents that is large and complete does not suit the needs of the new situation. Seen from the experience abroad, construction contingents which are small and specialized and are good at many things and expert in one have strong fighting strength, are quick in action, have high work efficiency and they should be the orientation of development. Without expertise an enterprise will not have distinguishing features and will find it difficult to establish a reputation. Without different skills an enterprise will lack the ability to meet contingencies. We assume that we can set up some specialized

engineering bureaus, specialized corporations and small specialized teams, break through professional boundaries and undertake the specialized tasks within the hydropower system or in and out of the country.

8. Build the construction base, reduce front construction personnel

There are 16 engineering bureaus in the water conservancy and power system. Staff worker contingents move with the projects. Each construction site builds 400,000 to 500,000 square meters of housing space which not only increases project investment but also extends the preparation time for construction and overburdens the enterprises. According to estimates, investment on housing for construction of the Wujiangdu hydropower station is 33 million yuan, about 5.6 percent of the total investment. If there is a construction base, about 13 million yuan in investment can be saved by building less housing at the construction site. We assume that in the future we can annually arrange for 2,000 to 3,000 people to move along with families of staff workers to enterprises of the system of ownership by the collective at the construction base where they will have independent accounting, be responsible for their own profits and deficits and earn according to the amount of work performed. This will reduce the on-site temporary housing and the number of construction workers and will promote a new contingent.

In short, there are potentialities in shortening construction time and lowering the cost of large-sized hydropower projects. If the state conscientiously safeguards capital, materials and equipment, by working hard it is possible to shorten the total construction time of large-sized hydropower projects by 2 years as compared to projects under construction and lower project investment (excluding permanent installations and immigrants) by 20 to 25 percent.

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CSO: 4013/199

## BRIEFS

NATION'S LARGEST TURBOGENERATOR--After 72 hours of successful trial operation, a large bulb, axial-flow water turbogenerator was recently turned over to and put into operation at a certain power station in Guangdong Province. As the first of its kind in China, and being produced on a trial basis by the Tianjin Power Generation Equipment Plant, this turbo generating unit has filled in the domestic gaps in the big-power and low-head hydraulic power generating equipment. With a total weight of 580 tons, this 10,000-kW hydraulic turbine unit is the largest and the most powerful low-head water turbogenerator in China. [Excerpt] [Tianjin TIANJIN RIBAO in Chinese 24 Aug 84 p 1 SK]

CSO: 4013/2

THERMAL POWER

## HUGE PLANT MAY BE BUILT IN NORTHWESTERN SHANXI

Taiyuan SHANXI RIBAO in Chinese 3 Sep 84 p 1

[Text] The Energy Base Planning Office of the State Planning Commission and the State Council convened a meeting in Beijing in mid-July. With a firm understanding of the geology, hydrology, and transportation [of the region] the experts and scholars attending the conference were of the unanimous opinion that priority should be given to the development of the Hequ-Baode-Pianguan region of Shanxi Province. The State has decided to build a large-scale power plant in this region near [sources of] water and coal, with arrangements to be made during the Seventh Five-Year Plan. In its final form, this power plant could reach 6 million kilowatts.

In September of last year, after the heads of the State Planning Commission has visited western Xinzhou Prefecture, they proposed that a pit-mouth power plant with an installed capacity of 3 million kilowatts be built in the Hequ-Baode-Pianguan region. The provincial party committee and government focused on this idea and sent a standing committee member to convene a He-Bao-Pian power plant initial phase work meeting. They also set aside some 6 million yuan for this phase of the work. At the same time, it was decided to put Chief Engineer Du Jimin of the Provincial Planning Committee in charge of organizing such involved departments as coal, geology, electric power, and railroads to quickly begin survey work and work up an engineering feasibility study. Beginning in March of this year, Shanxi Province's involved departments sent several dozen drilling machines and some 2000 technical personnel to the He-Bao-Pian region. Though plagued with difficult terrain and supply problems, they nevertheless finished a power plant feasibility study in July. It has been established that the He-Bao-Pian region is part of the western Hedong Coal Field, which has reserves of 36 billion tons of coal suitable for strip mining; the region now has 99 county and commune coal mines producing more than 2 million tons a year. By adding new strip mines, it would be possible to have "small mines supplying big power plants." There are abundant water resources in the region; Hequ's Longkouquan and Baode's Tianqiao river systems have an exploitable flow volume of 6 to 8 cubic meters a second--2 cubic meters a second already flow on the surface--enough to meet the needs of the first stage of construction calling for the installation of 1.2 million kilowatts. As for transportation, the area now has the two highways connecting Yangfangkou and Hequ and Baode and the special railroad from Shenchi to Hequ is now under construction. The 35-kilometer-long railroad from Shenchi to Sanchakou should be in operation this year and work on the 97-kilometer-long railroad from Sanchakou to Baode will be undertaken in the future.

CSO: 4013/15

## BRIEFS

SICHUAN'S FIRST HEAT-POWER PLANT--In early August, ground was broken for Sichuan's first combined heat and power plant, an energy-saving operation, at the Leshan Pulp Mill. Rather than disperse the heat, this plant will concentrate it, saving some 30,000 tons of standard coal a year. At the same time, the plant will reduce the discharge of particulate matter into the atmosphere by 70 percent. After this plant has been built, it will generate 3.5 trillion kilocalories of heat and more than 300 million kilowatt-hours of electricity a year. [Text] Chengdu SICHUAN RIBAO in Chinese 19 Aug 84 p 2]

CSO: 4013/236

COAL

## ACHIEVEMENTS OF COAL INDUSTRY IN PAST 35 YEARS REVIEWED

HK100950 Beijing RENMIN RIBAO in Chinese 6 Sep 84 p 1

["Facts and Figures" column based on data provided by the Ministry of Coal Industry: "Black, Shining Coal Churned Out in an Endless Flow Provides Large Amounts of Light and Heat for the People"]

[Text] Since the founding of the PRC, the coal industry has shown steady development, nudging the country into third place in world coal output.

### A Large Increase in Coal Output

In the 30-plus years from 1950 to 1983, national coal output showed a 21-fold increase, or an average annual increase of 9.6 percent. In 1983, annual output reached 715 million tons, fulfilling the "Sixth 5-Year Plan" 2 years ahead of schedule. Our coal output rose to third place in total world coal output from ninth place shortly after the founding of the country. The current output in 16 days is the equivalent of that of a year in 1949.

### An Improvement in the Distribution of Industry

In the past 35 years, the distribution of the coal industry has undergone tremendous change. Originally concentrated along the coast, it now covers all parts of the country. The country has 82 mining areas with an annual coal output of more than 1 million tons, 19 mining areas with an annual output of more than 5 million tons, and 11 mining areas with an annual output of more than 10 million tons. In recent years there has been very rapid development of small coal mines. At the end of 1983, the country had more than 40,000 small coalpits. Various provinces and regions and more than 90 percent of countries with coal resources had coal mines. In 1983, local coal output reached 350 million tons, accounting for 49.2 percent of the national coal output. Of this amount, coal output from small village and town coal mines reached 170 million tons, representing 24 percent of the national coal output.

### The Degree of Coal Mining Mechanization Has Been Raised

Both partial and complete mechanization have been achieved in coal mines with fixed state quotas throughout the country. In 1983, the country had eight comprhensive coal mining teams, with an annual output breaking the 1 million-ton

mark to reach the advanced world level. At present, the country's coal mines have 275 sets of multipurpose coal mining equipment. Coal extracted with multipurpose coal mining machinery in 1983 accounted for one-fifth of the output of mines with fixed state quotas.

Focus on Coal, Seek Comprehensive Utilization

In recent years, achievements have been made in using Gangue with relatively high heat value to generate electricity. At present, five Gangue electric power stations have been set up with an installed capacity of 80,000 kilowatts. Electric energy production in 1983 reached 230 million units. Gangue has also been used to produce various kinds of construction materials. In 1983, 1.3 billion Gangue bricks were produced and 550,000 tons of Gangue cement turned out. In addition, some coal mines have developed the gasification of coal, utilization of gas, the retrieval of sulphur iron ore, and the extraction of such chemical products as Montan wax, chlorinated aluminum, aluminum polymers and so forth.

CSO: 4013/240

## NATION'S STRAINED COAL SUPPLY SITUATION NOW EASING

Fuzhou FUJIAN RIBAO in Chinese 28 Aug 84 p 3

[Text] China's strained coal supply situation is becoming less acute. This year, over 98 percent of the coal supply and sales contracts have been fulfilled. This situation has been made known following a report-back meeting on the management and administration of state unified distribution coal mines just concluded in Ningxia.

According to statistics, in the first half of the year, total coal supply came to 189,861,000 tons, exceeding the plan by 1.355 million tons, or 5.8 percent more than in the same period of 1983. Coal supplied to departments under the party Central Committee [and State Council] came to 99.62 percent of the plan, or 9.95 percent more than in the same period of 1983. Industrial coal supplied to provinces, municipalities, and autonomous regions came to 102.6 percent of the plan, an increase of 2.5 percent over the comparable period in 1983. Because the rate of contract fulfillment increased, a good supply of coal was guaranteed for major enterprises, basically meeting the requirements for increased output for the first half of the year. The reserve of coal was also larger than in the same period for 1983, as the nation's strained coal supply situation was eased. According to a survey made at the end of June [1984], an increase was noted for the reserves of coal for the four major power grids of Beijing-Tianjin-Tangshan, the Northeast, the East, and Central China, for coal-burning locomotives, and for the reserves of coking coal for the 12 major iron and steel mills. Reserves of the nation's market coal were also up, assuring continued industrial output and a pre-stocked supply for coal for the winter.

CSO: 4013/8

## MODERNIZING COAL INDUSTRY WITH FOREIGN TECHNOLOGY

### Jining, Sitai Mines Compared

Beijing ZHONGGUO MEITAN BAO in Chinese 25 Jul 84 p 1

[Article: A Sharp Contrast: Two Kinds of Construction, Two Kinds of Results; Jining Number 2 and Sitai Mines Import Advanced Foreign Technology, Capital Is Saved, Mining Date Advanced, Economics Improved"]

[Text] Materials recently released by the sectors concerned reveal that the construction of two new mines has seen a modernization of techniques, a savings of capital, an advance of the mining date, and an efficiency of economics due to the results of taking advice from abroad on the import of technology and conducting advance feasibility studies jointly with the foreign sector.

One of the mines is Shandong's Jining Number 2. It was originally designed by the Coal Mine Design Institute of Yanzhou, Shandong. In 1983 with the receipt of state approval, the mine became a joint venture of the China Coal Development Company and Shell Coal International. Both sides began feasibility studies immediately. Guided by thoughts of modernized technology and economic savings, it was decided to import advanced coal mining technology, equipment and management from England, and the original design program for the mine was altered considerably. To compare the program before and after the revisions, we see: production capacity raised from 2.4 million tons to 3.3 million; coal work faces reduced from 10 to 4; tunnelling machines reduced from 25 to 11; tunnel length reduced from 59,870 meters to 33,000 meters; the mine construction period reduced from 6 and a half years to 5 years. Moreover, coal will be mined after only 2 years of construction, producing 1.8 million tons in advance of the completion of the construction period, and advancing a return of 45 million yuan. There will be a large-scale reduction of mine personnel, from 6,300 to 1,300. Labor efficiency will be raised from 1.8 tons per worker to 8 tons per worker.

The other mine is the Sitai Trench mine at Datong, Shanxi. This mine was originally planned by the Shandong Provincial Coal Mine Planning Institute. It was regarded by many comrades to be rather advanced considering China's general level of coal mining at the time. In 1983 it was proposed by the Ministry of Coal Industry that the mine go into cooperation with Japan, to import advanced technology, equipment and management, to build a model

modernized mine. At the end of that year the China Coal Development Company and Mitsui Kozan Kabushiki Kaisha signed an agreement, with Mitsui to provide technical advice on the design of the actual mine and the coal washing plant. The Japanese produced a design program which, when compared to the original, increased production capacity by 500,000 tons, increasing annual design capacity to 4.5 million tons; work was reduced, pit shafts reduced from 4 to 3 and mining work faces reduced from 43 to 24, tunnel length reduced by 18,600 meters; construction time was shortened from 5 to 3 years, with mining to start two years earlier than planned; personnel size was reduced and efficiency increased, the underground work force reduced from 6,240 to 2,455, with productivity increased from 2.1 tons per worker to 6.1 tons per worker. In addition, it is possible to greatly reduce the amount of real estate required by the industrial plant. Although the question of the value of investing in new design programs as they involve importing advanced technology, has not been assessed, it can be confirmed, if only from the above comparisons, the economic benefits truly are considerable.

## Coal Industry Urged To Woo Foreign Investors

Beijing ZHONGGUO MEITAN BAO in Chinese 25 Jul 84 p 1

[Editorial: "Lift Restrictions on Foreign Involvement in Our Coal Industry"]

[Text] We request that you read the report on the contrasts in the designs for the Jining and Sitai mines. To get past the technical and economic differences between Chinese and foreign design, it can be seen that importing advanced technology is of major importance and necessity to speed up the progress of modernizing China's coal industry, and to realize good economic benefits.

"Stimulate the economy at home and lift restrictions on that abroad" are two major tenants of China's socialist economics, and are included as state policy in the constitution. Recently, Party Central, the State Council and leading comrades have stressed that our present policy of lifting restrictions on foreign involvement is done not with the intention of "getting" but with the intention of expanding. This guiding thought is the key to the development of our coal inaustry. Since the Third Party Congress the coal industry has made definite progress in importing new foreign technology, techniques, equipment and using foreign capital, but speaking generally, our understanding is insufficient, and we have not done nearly enough work. The gates of lifted restrictions have not swung sides wide open and we are left with a "half hidden door" effect.

First, the utilization of foreign capital has not been opened up. In the last few years we have brought in very little foreign capital, and the amount will never be able to meet the needs of construction; as for that capital we have received, due to lack of experiences and other shortcomings, we have not been able to manage it fully. Next, and also very important,

is that for quite a long time in the past we were unable to import advanced foreign technology, techniques and equipment in any sort of timely manner or in any great amount. The more we used, themore we bungled some great opportunities. Although we have discovered this fault in the last 2 years, we are very slow in turning away from it.

What has created this stalemate is a problem in understanding. In a word, we have a closed-door country with the ludicruous conceit of the king of Yelang.

Fettered as we were for such a long time by "left" thinking, there are still comrades today with a lopsided view of "self-strengthening". They feel that we should always rely on ourselves and never ask of others. If you do ask of others, then the less asked the better. What these comrades fail to understand is that the thought that a country can set itself off independent of the world and attempt to solve all its economic and technical problems relying only on itself is an ignorant and backward point of view. Modern economic development requires every type of modern technology, as well as all natural resources and all funds. Not a single nation in the world has resources and technology enough of its own to meet the needs of its own economic development, much less China, a country that is rather backward in technology and lacking in funds. Lifting restrictions on the foreign side is a requirement of our national conditions.

Because of this lopsided view of self-strengthening, there are certain comrades who overestimate themselves, the "ludicruous conceit of the king of Yelang." They can handle anything by themselves, they think, and there's nothing more to be said. They do not admit, or do not wish to admit, that China's coal industry, compared to that of the developed nations, lags behind in technology, and in some aspects the gap is rather large. Certain technical problems have been solved by others, yet we are organizing our personnel and energies to "storm the pass," with the result that we go in roundabout ways, getting half the result for twice the price. This way of doing things, when global technology is available to all, is really bungling an opportunity.

To sum up, the coal trade should put into effect the state policy of lifting restrictions on things foreign, it must get rid of the "left" influence, and smash the closed door country mentality. Only when our understanding is raised and our thinking becomes proper will our eyes see, our ears hear and our courage grow robust. Only when we reform our work with things foreign on this basis will we truly be able to step out and absorb all the foreign capital available to us, to pluck all the brilliant blossoms of technology we can use, and greatly accelerate the course of modernization of China's coal industry.

12263
CSO: 4013/220

COAL

GROWTH OF COAL INDUSTRY IN NORTHEAST SINCE 1949 TRACED

Beijing XINHUA in English 1233 GMT 13 Sep 84

[Text] Changchun, 13 Sep (XINHUA)--Coal mining officials in northeast China expect regional output to reach 91.15 million tons this year--a 650 percent increase in annual production over that [since] the birth of new China.

The Northeast China and Inner Mongolia Joint Coal Coal Industrial Corporation said today that this figure did not include the coal mined at small pits run by local authorities.

The northeast region has been China's major heavy industrial centers since 1950's. To ensure the supply of energy, great efforts have been made to develop the coal industry. In the past 5 years, new mines have been built and old ones upgraded while exploration of coal reserves stepped up.

The corporation's output last year reached 89.56 million tons. Officials predicted that pooduction in the region would increase at an annual rate of 5 percent to reach 120 million tons by 1990, accounting for about a quarter of the country's total output by major mines under the Ministry of Coal Industry.

The northeast China and the adjacent Inner Mongolia region claim to have nearly 50 billion tons of reserves, the second largest coal mining area in China.

Over the next 5 years, according to the corporation, 22 new mines will be built and 21 old ones upgraded. This should add 49 million tons to the present annual production capacity.

The first stage of construction at the Huolinhe opencast mine has been completed, and production began earlier this month. It can produce 3 million tons of coal a year.

The second phase, to begin soon, will add capacity for another 4 million tons a year.

Two other large opencast mines at Yiminhe and Yuanbaoshan are also being built.

CSO: 4010/12

## SINO-U.S. JOINT VENTURE IN PINGSHUO UNDER WAY

OW262210 Beijing XINHUA Domestic Service in Chinese 0214 GMT 24 Aug 84

[Article by reporter Wu Xinwen and correspondent Zhong Xinying]

[Text] Taiyuan, 24 Aug (XINHUA)--The construction of the Antaibao large open-cut coal mine in Pingshuo area of Shanxi Province, China's largest open-cut coal mine jointly developed and operated by China and the United States, has started in an all-around way. Nearly 5,000 mine construction workers are working hard there. The Antaibao area, on a plateau north of the Great Wall which used to be a bleak and barren area, is now the scene of busy activities.

The Sino-U.S. agreement on cooperation in developing the Pingshuo Antaibao open-cut coal mine was signed in April of this year. It is an agreement signed between China and a foreign country on the largest joint venture thus far. Of the total investment, which amounts to some $600 million, the U.S. side contributes 59 percent and the Chinese side 42 percent.

The large open-cut coal mine, with an area of 17.7 square km, is located in Pinglu and Shuoxian counties in Shanxi Province. It has 450 million metric tons of coal deposits. It is scheduled to be completed at the end of 1986 and is designed to produce 15 million metric tons of coal annually. The two sides will jointly operate the mine for 30 years.

The construction of this large open-cut coal mine is being constantly accelerated by experienced and skillful construction workers from the No 13 Metallurgical Company of the Ministry of Metallurgical Industry. Of the mine's 210 construction projects, 71 have started. A flood diversion project and a highway between Shuoxian County and the mining district have been completed. A large coal-dressing plant, a machinery repair plant, fuel storage tanks, and a special railroad are under construction. In the first-stage housing project, apartment buildings with a total floor space of 170,000 square meters have been completed. More than 3,000 metric tons of steel structures and equipment supplied by the U.S. side for the construction of the machinery repair plant and two other buildings have been delivered to the construction sites. The assembly of the structures and equipment will be completed and put into use by the end of this year.

Experts, engineers and technicians dispatched by the U.S. side are working at the construction sites. They are directing the construction and conducting geological surveys to ensure the construction proceeds smoothly.

CSO: 4013/240

## PINGSHUO: SUCCESS STORY FOR SINO-U.S. JOINT VENTURE

Beijing ZHONGGUO MEITAN BAO in Chinese 28 Jul 84 p 1

[Article by Zhou Shijun [6650 0013 0971] and Xiao Jiang [2556 3068]: "Construction of Pingshuo Open Pit Mine Under Way"]

[TEXT] The construction of the Pingshuo Antaibao Number 1 open pit mine industrial zone and living zone, a Chinese-American joint venture and one of the major construction programs for China's coal industry, is now under way. The work completed in the first half of this year amounts to 15.3 percent of the capital construction cost, or 107,120,000 yuan.

The industrial zone is a Chinese-American joint venture with a capitalization of $249 million U.S. At present the work of preparing the infrastructure for the construction project has been completed. The 20.66 km long highway from the industrial zone to the living zone is essentially complete; temporary 110,000 volt power lines have been installed; work on rechanneling 8.25 km of the Qili He is complete; water well exploration, drilling and pump testing is complete, with 34,000 tons a day available, providing a stable water supply that will not affect surrounding towns; water mains for the mine area are almost complete; work is starting on railway overhead wires, oil dumps, job site offices and other industrial installations. Surface grading has been completed for the coal washer and equipment repair center. The living area is capitalized entirely by the Chinese side, the construction will occupy 280,000 square meters. By the end of this year construction of basic living and dining areas for Chinese and foreign personnel will be complete. Pingshuo, a major construction target, is permeated with the socialist spirit of cooperation. To ensure that the project would be speedily completed and put into operation, whenever working plans were drawn up for one aspect in accordance with the demands of the total project, they were rushed into construction, so breakthroughs were made in a fairly short time. Local government has given the project a green light, land was used first and legally taken later, the Bank of China broke the normal rules to make temporary loans when capital was short. To ensure quality control of the works, each project was contracted for and done by specialists. So that coal dragging may begin next February, the Pingshuo Coal Company has opened a training center. This April, when the American side sent observers to the works, they checked on the technical proficiency of the training center personnel. They happily reported that "The Preparatory work on the Chinese side is running ahead of our own."

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CSO: 4013/220

## SHANXI COAL INDUSTRY BOOMING, MUCH HEAVIER OUTPUT PROJECTED

### A Coal Train Every Six Minutes

Beijing RENMIN RIBAO in Chinese 15 Aug 84 p 3

[Article: "A Coal Train Every Six Minutes--Coal Output in 1983 Was 57 Times Greater Than in 1949--Coal Industry in Shanxi Has Made Enormous Contribution to Nation"]

[Text] Comrades in the coal industry and in communications and transportation departments in Shanxi told this reporter that in the first half of this year, a train laden with coal was being produced every 6.32 minutes for shipment from Shanxi to all areas of the nation.

Shanxi has abundant coal resources. There is a full range of product varieties with excellent quality, as is well known. Coal output in Shanxi has increased 57 times since the founding of the country. Shanxi provided the nation with a total of 1.848 billion tons of raw coal from 1949 to 1983, equivalent to one-fifth of total national output. More than 1 billion tons of coal have been sold outside Shanxi to 26 provinces (and municipalities), as well as to Japan, England, France, Italy, Bangladesh and other countries.

The flourishing development of the coal industry in Shanxi is a magnificent victory for the lines, directions and policies of the party since the founding of the nation, and especially since the Third Plenary Session of the 11th CPC Congress. Annual coal output in the province was only 2.7 million tons in 1949. There was an average increase of 3.29 million tons per year from 1949 to 1978. After the Third Plenary Session of the 11th CPC Congress, leading comrades of the Central Committee paid several visits to Shanxi and gave important guidance to the development of the coal industry in the province. This led to a new situation of "large-scale extraction in large mines and turning over extraction in small mines, so that mines are run in unison by the state, collectives and individuals." Annual raw coal output surpassed the 100-million-ton level in 1979, and reached 159 million tons in 1983. This was an average annual increase of 12 million tons over a 5-year period.

The following mines have sprung up in Shanxi in the flourishing development of the coal industry: the Datong Mining Bureau, with an annual output of more

than 27 million tons, a scale found in few places in the world; a group of highly mechanized, high output, high efficiency and safe model national mines such as the Wangzhuang Coal Mine, the Shigejie Coal Mine, the Guandi Coal Mine, and the Yungang Coal Mine; and advanced collectives with an annual extraction amount greater than 1 million tons, such as the Tongjialiang Mine Number 1 Comrpehensive Extraction Team, the Yongdingzhuang Mine Number 4 Comprehensive Extraction Team, the Wangzhuang Mine Number 1 Comprehensive Extraction Team, the Guandi Mine Number 2 Comprehensive Extraction Team, and the Duerping Mine Number 2 Comprehensive Extraction Team.

The development of the coal industry has carried along and promoted the development of other industries. Eighty-five percent of the total amount of rail transport in Shanxi involves the shipment of coal outside of the province, with a succession of coal cars being shipped to the rest of the country through seven shipping centers. Seventy percent of highway transport involves the shipment of coal, and more than 5,000 trucks leave every day to transport coal outside the province, traversing the 27,800 kilometers of highways in the province. We have developed 86 large, medium and small scale chemical fertilizer plants that use coal as a raw material with an annual production capacity of 650,000 tons of synthetic ammonia, and the Shanxi chemical fertilizer plant with an annual output of 300,000 tons is now under construction. Pit-mouth power plants and thermal power generation plants are scattered across the province. Some 1.38 billion KwH of electricity were transmitted to the Beijing, Tianjin and Xian power grids in 1983. Machinery, metallurgical, heavy and chemical industries have grown rapidly along with the coal industry. The magnificent prospects for the energy, heavy industry and chemical industry base areas in the glorious motherland have made themselves visible to the people of Shanxi.

## Output to Top 300 Million Tons By 2000

Beijing RENMIN RIBAO in Chinese 15 Aug 84 p 3

[Interview with Governor Wang Senhao [3769 2773 3185] of Shanxi Province: "Beautiful Prospects for the Coal Industry in Shanxi--A Visit With Shanxi Governor Wang Senhao"]

[Text] The 12th CPC Congress set forth the magnificent goal of guadrupling the total value of industrial and agricultural output by the end of the century. What are the prospects for the heavy industry and chemical industry base areas in Shanxi that are key national construction projects? The governor of Shanxi Province, Wang Senhao, answered in a few words: "beautiful prospects, a gratifying situation."

"Total coal output in Shanxi will reach 360 to 400 million tons by the year 2000, a 2.3-fold increase over the 120 ton level in 1980. The proportion of total national raw coal output produced in Shanxi will grow from one-fifth to about one-third. Shipments out of the province will increase to 300 million tons, up from 72 million tons in 1980." Wang Senhao said, "In the distribution of extraction, we have the power coal base area centered on the Ningwu Coal Field, the anthracite base area centered on the Qinshui Coal Field (including Yangquan, Pingding, Qincheng, Yangcheng and other areas), and

the coking coal base area centered on the Hedong Coal Field (including the Xishan area of Taiyuan, Huoxian County, Xiangning, Lishi and other areas). The new and expanded production capacity totals 310 to 350 million tons, of which 180 to 200 million tons, or about 75 percent of the total, comes from the transportation of existing mines. The capacity of newly-constructed mines totals 130 to 150 million tons, or about 43 percent of the total. The capacity for raw coal dressing has reached more than one-third of total output.

"On the basis of the flourishing development of coal production, other industries that use coal as a primary raw material also are undergoing major developments. Seven large industrial and mining regions will be constructed in the province by the end of the century. They are: 1) The Gujiao Mining Region, which is a national coking coal production base area whose construction was arranged in the Sixth 5-Year Plan. Annual raw coal output will be 16.5 million tons after the mines go into operation. 2) The Pingshuo Mining Region (including the Shentou Thermal Power Plant), with a design capacity of 45 million tons and a power generation capacity of 1.35 million Kw. 3) The Lucheng Industrial and Mining Region, which includes the Shanxi Chemical Fertilizer Plant with an annual output of 300,000 tons of nitrate and phosphate fertilizers, the Lucheng Cement Plant with an annual output of 750,000 tons of cement, and the Zhangze Power Plant, with an installed generator capacity of 1 million Kw. Moreover, there also are the Hejin Industrial and Mining Region, the Liulin Industrial and Mining Region and the Yangcheng Industrial and Mining Region. These industrial and mining regions will be built into new industrial cities with a population of 200,000 to 300,000 by the year 1990. There will be a 1.2 fold increase in nitrogenous fertilizer output and a 3.2 fold increase in phosphate fertilizer output in Shanxi by the year 2000. There will be a substantial increase in thermal power generation, and most county seats will basically be changed over to gas."

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CSO: 4013/221

## SICHUAN'S ENERGY GROWTH MATCHING INDUSTRIAL DEMAND

Chengdu SICHUAN RIBAO in Chinese 1 Aug 84 p 2

[Article: "A Rapid Increase in Energy Resources in Sichuan Over Past Year--Needs of High Rate of Industrial Growth Basically Met"]

[Text] There has been new growth in the energy industry in Sichuan over the past year. From January through June, output of primary energy resources totalled 21.715 million tons of standard coal, and 55.24 percent of the annual plan was completed. This was 9.96 percent higher than for the same period in 1983, and the rate of growth was one of the highest in recent years. Added to conservation, energy resources in the province are basically meeting the demands of a high rate of industrial growth.

In total output of primary energy resources in Sichuan over the past year, the rate of increase was highest in raw coal. Key coal mines are continuing to maintain stable growth, and the rate of growth in coal in town and township enterprises was even higher. This has alleviated the coal supply shortage in Sichuan. Because of the strengthening of production organization and management in the Petroleum Bureau, there has been continual stability in the extraction of natural gas this year, and there even has been some increase. In the area of electric power, during an especially arid dry season, due to the coordination of coal, electricity and transferring, and to relative normality in thermal electric power generation, the total amount of electricity produced and sold in the province from January through June was 10.42 billion KwH, a 6.9 percent increase over the same period last year.

The main reason for the fairly good situation in energy production in Sichuan during the first half of the year were, first, that economic reforms greatly motivated the initiative of the broad masses of employees on the energy front, second, that energy production departments have paid attention to stability, balance and safe production from beginning to end in the organization of production, third, that the related departments have paid attention to coordination and have made quick attempts to solve key problems affecting the development of energy production. The fourth is that they have continued to organize coordination and competition among coal, electricity and transfer.

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CSO: 4013/221

## 'EASTERN COAL COMPANY' WILL MINE 124 MILLION TONS IN 1990

[Beijing RENMIN RIBAO in Chinese 20 Jul 84 p 2]

[Article by XINHUA reporter Chen Guangjun [7115 1684 0193]: "Eastern Coal Company Contracts With Ministry of Coal Industry for Coal Production To Hit 124 Million Tons in 1990"]

[Text] Changchun, 19 July: The Nei Mongol and Northeast Coal Company (abbreviated "Eastern Coal Company") has contracted with the Ministry of Coal Industry for a coal production target for the period 1985 to 1990, as well as tonnage coal capitalization and basic construction targets. As the contract is part of the program of nationwide coordinated joint coal mine contracts recently put into effect by the Minister of Coal Industry, Gao Yangwen and approved in principle by the State Council, Gao personally went to the company during working hours to sign it. Eastern Coal's planned production for 1984 is 91,150,000 tons; the production target contracted with the Ministry for 1985 is 94,400,000 tons. The Seventh 5-Year Plan Period takes 1985 as the base year for target contract figures, with the annual increase to be 5 percent. So by 1990 the company's coal production should reach to over 124 billion tons. In this way, the Eastern Coal Company may help alleviate the coal shortage in the Northeast.

Ministry head Gao Yangwen said "The magnitude of the Nei Mongol and Northeast Coal Company's contracted coal production target increases is greater than the average increase for the entire nation's coordinated coal mine contracts, this should definitely have the effect of boosting other coordinated coal mines' contracts."

Formed last year as the nation's largest inter-regional entity in the coal industry, Eastern Coal's produces one-fourth of the nation's coordinated coal mine output.

To ensure that the company meets its contractual duties, and to stimulate coal production, Gao Yangwen delegated certain powers normally exercised by the company to the deputy bureau cadres. These powers include: power to hire and fire, power to sell coal produced in excess of production targets, and partial power to review and approve new construction work.

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CSO: 4013:207

## LIAONING LOCAL COAL PRODUCTION EXPANDING RAPIDLY

OW101739 Beijing XINHUA in English 1435 GMT 10 Sep 84

[Text] Shenyang, 10 September (XINHUA)--Liaoning Province in northeast China has spent over 100 million yuan over the past 4 years supporting local small coal mines to expand production while vigorously developing state-run major mines, according to the provincial government.

Now in operation are 45 mines opened by cities and counties and 365 coal pits run by townships. The provincial government provided them with props, granted tax reductions or exemptions and sent people to find coal for them.

These small coal mines produced more than 4.5 million tons in the first 8 months of this year, over 550,000 tons more than the same period of last year. The annual output accounts for 17 percent of the provincial total.

The local coal production boom helped in a way to alleviate energy shortage of the province, a major industrial center of China.

Liaoning had only a few small coal mines run by localities during the early post-liberation days. The annual output at that time was only about 4,000 tons.

A big progress has been made since 1978 when the provincial government began to give priority to energy development. Over the past 3 years, coal output in small mines increased by 500,000 tons each year.

The city- or county-run coal mines have been basically mechanized and small coal pits run by townships have also mechanized their tunneling, conveying and lifting systems.

CSO: 4010/1

## FLUIDIZED-BED BOILERS BURN COAL WASTE TO GENERATE ELECTRICITY

Beijing RENMIN RIBAO in Chinese 8 Aug 84 p 1]

[Article: "Gratifying Results Using Gangue and Stone Coal To Generate Electricity; New National Policy To Increase and Encourage Its Use"]

[Text] Gratifying results have been obtained by several coal mines around the nation in actively utilizing gangue and stone coal for the production of electricity. Five power plants have been built at the mouths of gangue and stone coal pits, with a total generating capacity of 82 megawatts. Last year these plants burned 600,000 tons of gangue and stone coal, producing over 210.1 million kWh, with a savings of 250,000 tons of raw coal. This year to date they have utilized over 400,000 tons of gangue and stone coal.

The Sichuan Yongrong mine bureau power plant was China's first power station to be built at the mouth of a gangue pit. This plant, with the cooperation of Chongqing University and the Dongfang Boiler Company, converted four old boilers into gangue-burning fluidized-bed combustors. The largest of these has a furnace heat efficiency of 78 percent, runs an average of over 6,000 hours a year, and may be fired continuously for 2,000 hours with its load in the 40 to 100 percent range. Steam parameters are constant and combustion conditions are normal. Electric production cost was 116 yuan for every 10,000 kWh when burning raw coal; after switching to gangue, the cost was lowered to 47 to 52 yuan.

Other units, including the Jiangxi Pingxiang mine bureau, the Heilongjiang Jixi mine bureau and the Hunan Yiyang experimental stone coal electric plant, have all carried out studies and trials of fluidized-bed combustors. The Didao power plant of the Heilongjiang Jixi mine bureau has installed two of the largest capacity fluidized-bed combustors in the country and two 25 megawatt generator installations, making it China's largest gangue-burning power plant.

In order to accelerate the pace of development of gangue-burning electric power generation, the State Council approved the new policies of the State Planning Commission and the Ministry of Coal Industry aimed at encouraging gangue-burning electrical production. China is rich in gangue, 100 million tons are separated out each year. Some of that has a heat value of over 1,500 kilocalories per kilogram, particularly the washed gangue produced by coal washing plants; most of that can be used as fuel for fluidized-bed combustors. In the past, in the absence of sufficient capital and energetic policy, this abundant resource was not well utilized.

From 1985 to 1990, the Ministry of Coal Industry plans to build 45 gangue burning power stations in the immediate vicinity of coal washing plants in the areas of the Northeast, North China and East China that are experiencing power shortages. The new policy provides that the capital for the construction of the power plants be taken care of in the manner of low interest state loans, and that it be included in the annual coal capital construction budget target, the interest on the loans to be taken from the principal. The profits of the power plans will not be sent along to higher authorities, but instead will be used to pay off the loans.

Gangue and stone coal power plants are plants that provide for the needs of the coal mines themselves, generating electricity to be used at the mines. At the same time, they also belong to the category of utilization of the "three wastes," and are advantageous to environmental protection and the ecological balance. Consequently, the new policy stipulates that the state exempt them from the electrical sales-linked and electrical generation-linked business tax. The plants may supply power independently or in grids, and the right to buy and sell power shall not devolve to the electric authorities after the power enters grids. If surplus power enters the grids, then the electric authorities may only collect a grid cost fee, and return the profit to the coal mine, the purchase price to be determined according to the average price for borrowed power minus depreciation of the lines, approved staff welfare funds, incentive funds and administrative costs.

In order to secure the steel, lumber and cement needed for the construction of the gangue and stone coal burning power plants and related equipment, they will be included in the relevant state supply plan.

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CSO: 4013/207

## BRIEFS

**SHANDONG 35-YEAR OUTPUT--Over the past 35 years, Shandong Province has vigorously developed its coal industry. By the end of 1983, it had turned over a total of 729.3 million tons of coal to the state, an increase of 24.5 times over 1949. The number of coalpits increased from 16 pairs in the early Liberation Period to 161 pairs. At present, about 46.8 percent of the mining operations and 62 percent of the tunneling of provincial-run collieries are done by machines. [Summary] [Jinan Shandong Provincial Service in Mandarin 2300 GMT 11 Sep 84 SK]**

HEBEI COAL WASHING PLANT--Tangshan, 20 Sep (XINHUA)--Construction of China's largest coal washing plant furnished today, according to the Kauluan Coal Mining Administration here. Located at Fangezhuang Coal Mine, a major producer in northern China's Hebei Province, the coal washing plant comprises four units, capable of handling 4 million tons of coal a year. The plant's construction consists of two stages. The first stage, consisting of screening, dressing and concentration units, was finished last year and put into operation in May this year. The second stage--a drying unit--began in late April last year and is equipped with machinery imported from McNally Pittsburgh International Inc. of the USA. The whole drying process has been computerized. Manned by five operators, it is capable of handling 428 tons of coal per hour, making it China's most productive single drying unit. [Text] [Beijing XINHUA in English 1627 GMT 20 Sep 84 OW]

CSO: 4010/7

# OIL AND GAS PROSPECTS IN OVERTHRUST BELT ON WESTERN RIM OF ORDOS

Beijing SHIYOU DANTAN YU KAIFA [PETROLEUM EXPLORATION AND DEVELOPMENT] in Chinese Vol 11, No 1, 1984 pp 33-44

[Article by Liu Youmin [0491 0645 3046] and Kong Zhiping [1313 1807 1627], Institute of Petroleum Exploration and Development, Changqing Oil Field]

[Summary] I. General Outline

The overthrust belt on the western rim of the ordos basin extends from Shijushi, Ningxia Hui A.R., 420 km south to Pinliangxian, Gansu. It varies from 30 to 60 km in width. It lies on the transition zone between the Qilian geosyncline and the North China platform.

The northern half (north of Tianshuibao, Huanxian, Gansu) is 230 km long, 50 km wide, with flat terrain and good communications, and is a favorable place for exploration work. Since 1957 three Jurassic oil fields, Lizhuangzi, Dashuikang and Biyanjing, and the Triassic Majiatan oil field have been discovered, along with upper Paleozoic gas wells of commercial quality.

The southern half (from Tianshuibao to Pingliang) is 170 km long, 30 km wide. There is hope that oil and gas fields have been formed there too, though it would never equal the north half.

Four strata have been targeted for exploration in the Ordos basin: lower Paleozoic Ordovician; upper Paleozoic Permian and Pennsylvanian; upper Triassic; and lower Jurassic. These all show oil forming action, and the one place to profitably explore all of them is in the overthrust belt on the west of the basin.

Structurally the area is a geosyncline-platform transition zone, so it does not resemble geosyncline activity, as the structure is fractured, nor does it resemble a platform, there is no clear-cut folding, a good place for oil and gas accumulation. Each stratum is thicker here than on the platform. The sedimentation is a product of the Qilian trench, the North China Sea and the coastal trenches. In the continental-marine interfade the mesozoic strata are well developed. The sedimentation is fine, thick and deep. Obstacles to exploration have been: 1. Structural problems. There are over 100 faults, 100 local structures and fault blocks. 2. Retention.

While it seems there are definite shows of oil and gas, but what should be the actual oil field is lost as the main faults strike south. These problems should both be resolved through better understanding of the structure.

Coal gas and gelatinous oil extracts are the main things found in 18 upper Paleozoic wells drilled. Three have had oil flows and 13 have had shows of oil and gas.

II. Structure

There are four dissimilar zones in the area: the Shijushan fault and fold zone; the Hengshanbao fault and fold zone; the Majiatan fault and fold zone; and the Shajingzi-Pingliang fault and fold zone. The Hengshanbao area is the most standard, it is a north to south striking complex Paleozoic anticline zone, controlled by two north to south striking faults, but due to shallow depths, exploration wells have been fruitless.

III. Oil Generation and Accumulation

The area has the best oil generation strata in the Ordos basin, but the accumulating strata are less than i-eal. Faults and fussures may make up for the problems in permeability, however, with the result that this could be a low to medium producing oil and gas field.

The Ordovician has good oil generation potential, in particular the Kelimoli formation. Of particular note is that of the 15 wells drilled into the lower Paleozoic, 8 found various stages of oil and gas shows; 7 of these were in the western margin.

The Permian limestones form a complete oil forming system. Coal and associated mudstone is abundant here, accounting for the auspicious "coal gas".

The Yanchang formation of the Triassic is the main discovered oil generating rock, and this has already been reported on. The Jurassic and Triassic oil fields currently discovered owe their oil to that formation. But the Jurassic Yan'an formation of the southern part of the basin is an oil generating rock of secondary importance.

III. Prospects

Just as it took 30 years of drilling dry wells in Idaho and Wyoming to bring in the first well 1974, so too exploration work is difficult in the Ordos basin. But the oil generating conditions have been met, and there is complex enough structure to indicate that oil fields are located here. Generation, accumulation, capping, migration, trapping and preservation factors are all present here. But there are three things that affect what size the oil field should be: 1. No large structure. 2. Background value of animal and vegetable matter is low and varies. 3. The upper Shihezi formation and the Shiqianfeng formation are not ideal caps for gaseous matter.

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CSO: 4013/206

# IMPROVING DEVELOPMENT RESULTS IN THICK RESERVOIRS AT SHUANGHE

Beijing SHIYOU KANTAN YU KAIFA [PETROLEUM EXPLORATION AND DEVELOPMENT] in Chinese Vol 11, No 1, 1984 pp 64-69

[Article by Song Zhenyu [1345 2182 1342] of the He'nan Oil Field]

[Summary] Pay zones of from 4 to 6 meters in thickness account for 96.6 percent of the pay zones in the Shuanghe oil field. There are altogether 9 oil formations, 91 small faults and 351 tar sand bodies, with multi-strata exploitation going on. After 4 years of water injection, water has been found in 80 percent of the wells. An analysis of data from 22 wells over 33 small faults and 72 intrastratal sections shows that water has reduced the oil or blocked it off in 37.5 percent of the area. Inter-strata measurements show that only about 33 percent is diminished or blocked, so the problem is more severe at the intrastrata level.

It is necessary to carry out intrastrata separate zone techniques. There is a high degree of heterogeneity inside and between the strata. Permeability varies from area to area as determined by nine core sampling wells. The average index of heterogeneity is 4.66, greater than those of other oil fields in China (Daqing 1.49, Shengli 4,0, Yumen M reservoir 2.0, Kelimayi 1.55). Because of the history of sedimentation of the area, the rock types are fairly coarse and there is fairly large throating present in all oil reservoir rock types. The thick reservoir beds are made up of various rock types, and each has its own oil producing characteristics. Tests on fault block 437 showed that production was better when each rock type and formation within a layer was exploited separately. The rate at which water appears also varies with rock type; breccia[illegible]ciated sandstone and breccia bearing sandstone account for 79 percent of well strata sections with water present. Because of the high degree of homogeneity and the in layer beds within the oil strata not only are the differences in oil production and water absorption different, but intrastrata interference is severe.

It is possible to divide a reservoir stratum into separate flow units, so it is possible to carry out exploitation of small parts within thick reservoirs. The in layer beds within the strata can act as barriers, creating different flow units. Stratum IVI/4 of well $Bi^2$ has a top and bottom part, the top 3.8 m thick, pumps 43.2 tons per day, with the strength of 12.5 tons/day * meter, while the bottom part has a thickness of 2.6 m, a natural

flow of 76 tons per day and a strength of 29.2 tons/day * meter. Between them there is only a calcified embedded layer 1 meter thick. When water injection was applied to well $414^2$, water absorption was good in the top layer but deficient in the bottom; after that well went into production, $Bi^{2'}$s production dropped off to a daily production strength of 12.5 tons/day * meter on the top and 9.6 tons/day * meter on the bottom. The botton faired worse than the top due to interstrata changes. This shows that not only does the embedded layer provide a channeling effect, it also provides a stabilizing effect.

In order to carry out the work of in layer separation, it is necessary to do the following things:

1. Master drilling techniques to ensure well quality.

2. Increase intrastratal surveying.

3. Increase overall geological study.

4. Utilize gross dissection to come to an understanding of the key points of in layer separate zone techniques.

5. Establish principles for perforated casings and work out a scheme for their use:

a. Always use perforated casings in thick oil strata with no water present; use perforate casings as appropriate in stabilizing embedded strata between oil and water strata.

b. In rock with high permeability, institute the necessary controls to prevent the injected water from rushing along the high permeability layer.

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CSO: 4013/206

# MAINTAINING PEAK PRODUCTION AT DAQING IN ITS HIGH WATER-CUT PERIOD

Beijing SHIYOU KANTAN YU KAIFA [PETROLEUM EXPLORATION AND DEVELOPMENT] in Chinese Vol 11, No 2, 1984 pp 44-49]

[Article by Liu Heng [0491 1854] of the Development Department, Daqing Petroleum Administration Bureau]

[Text] Abstract. This paper takes as its point of departure the questions encountered during the last 3 years' peak production under high water-cut conditions at the Daqing oil field, and the potential for the oil field. It discusses whether it is possible to have peak production if the high water-cut period continues for a long time, and focuses on an analysis of the effects of the possible steady decrease of production over the high water-cut period, reservoir pressure becoming insufficient to raise the oil and results of measures to increase production on peak production. It proposes close spacing of oil wells, readjustments, and re-equipping oil wells to have the effect of continued peak production in the oil field.

After an oil field enters into the high water-cut period, the most important question we are faced with is: will we be able to continue to realize peak production? The Daqing oil field was founded on the guiding principal of "Maintain peak production and high production over a long period of time; strive for a high rate of recovery." In the early low and middle water-cut period of exploitation of the oil field, interior water injection, maintaining reservoir pressure, and flowing well types of water injection and drilling methods were employed, and were proved out in practice by their success. But after the oil field entered the high water-cut drilling period, how to continue to carry through with the guiding principal of our foundation? The last 3 years' preliminary experience in high water-cut exploitation have brought us to recognize that to realize peak production in a high water-cut period, only with the most difficult technical measures and intensity of work (and only apt measures and meticulous work) will it be possible to continue to stretch out the period of peak production.

## I. Important Problems Faced During High Water-Cut Exploitation Periods

Carrying out the policy of long-term peak production and high production was relatively easy before the middle water-cut period, and use of the above mentioned methods was enough to guarantee peak production. The problem is, when entering the high water-cut period of exploitation, will we be able to guarantee peak production. In water injected small oil fields at home and abroad, the time period for peak production is relatively short. In large oil fields using water injection, peak production is maintained only until the water cut equals 60 to 70 percent. In reality, after the water content reached 60 percent at the Daqing (Sa, La, Xing) oil fields, there was an overall disease. After 2 years, the decrease had reached 5.47 percent. Consequently, if limited to only the methods of the past, we would be unable to maintain continued peak production, due to several problems facing us now at an oil field in the high water-cut period:

### A. How Do We Overcome the Problems of Increased Deceleration of Oil Well Production Capacity and Loss of Natural Flow Pressure To Lift the Oil After Entering Into the High Water-Cut Period?

#### 1. Increased drop in oil recovery index

A great deal of statistical data shows that there is a clear increase in the rate of the drop of the oil recovery index as the water content increases after entering the high water-cut period under water lift conditions (Figure 1). To take the Lamadian oil field as an example, the relative oil recovery index was always 1.1 to 1.2 before the water content reached 60 percent; after entering the high water-cut period (water content 60 to 70 percent), there has been a drop of 1.7 percent in the average oil recovery index for every 1 percent, the relative oil recovery index falls 2.1 percent, and when the water content is 80 to 90 percent, the index drops 2.6 percent.

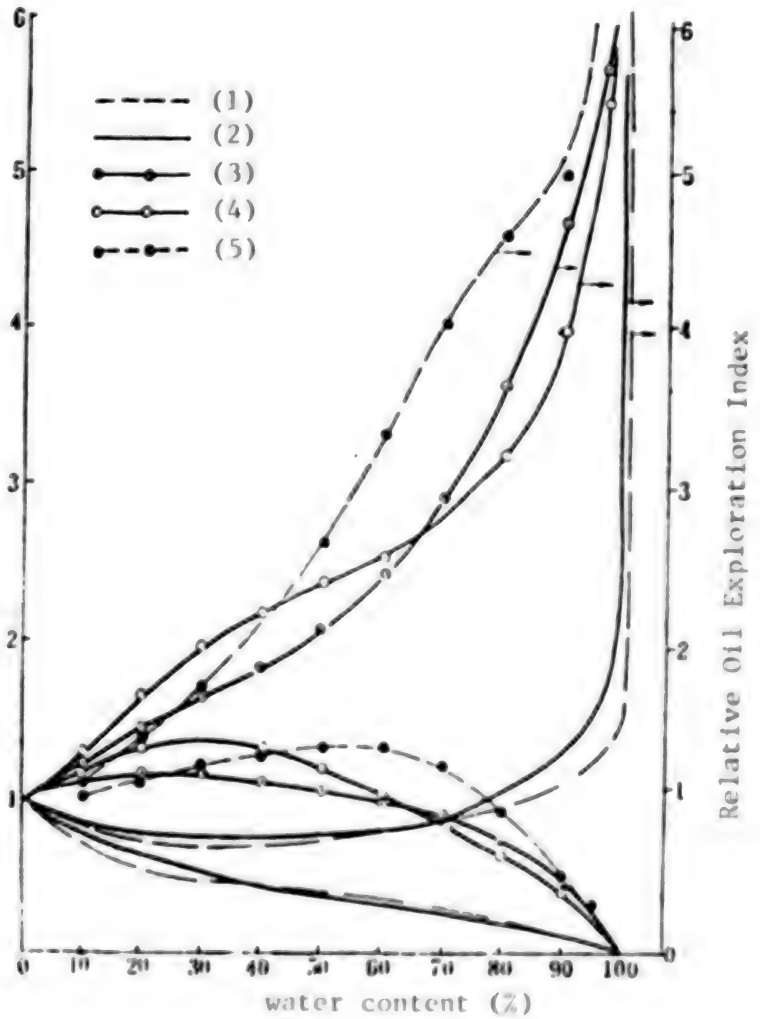
#### 2. Rise in flow pressure, diminished production pressure

Inside the oil string of an oil well using natural flow exploitation methods, the average specific gravity of the fluid column increase with the increase in water content. According to data on water content and flow pressure collected from each large exploitation area before entering into the middle water-cut period, there is a very good direct line relationship between them. After entering into the high water-cut period of exploitation, flow pressure accelerates upward. The entire experience derived from close-spaced well number 511 clearly points out this special characteristic of the relationship between oil string pressure losses and the amount of water content in water injected exploitation. In well group 511 on the Sa II $_{7+8}$ strata, before water content reached 60 percent, oil string losses increased by 0.14 atmospheres for every 1 percent increase in water content; after water content passed 60 percent, 0.45 atmospheres were lost in the oil string for every 1 percent increase in water content. Consequently, if the reservoir pressure stayed the same, then the rate of decrease in production pressure was accelerated. Calculations also show that as the water content increases, the well's natural flow potential is weakened, and at minimum it will rise to the point of stopping natural flow.

Figure 1. Relationship of water content to relative oil exploitation index and liquid production index in the close-spaced well thick strata experimental area.

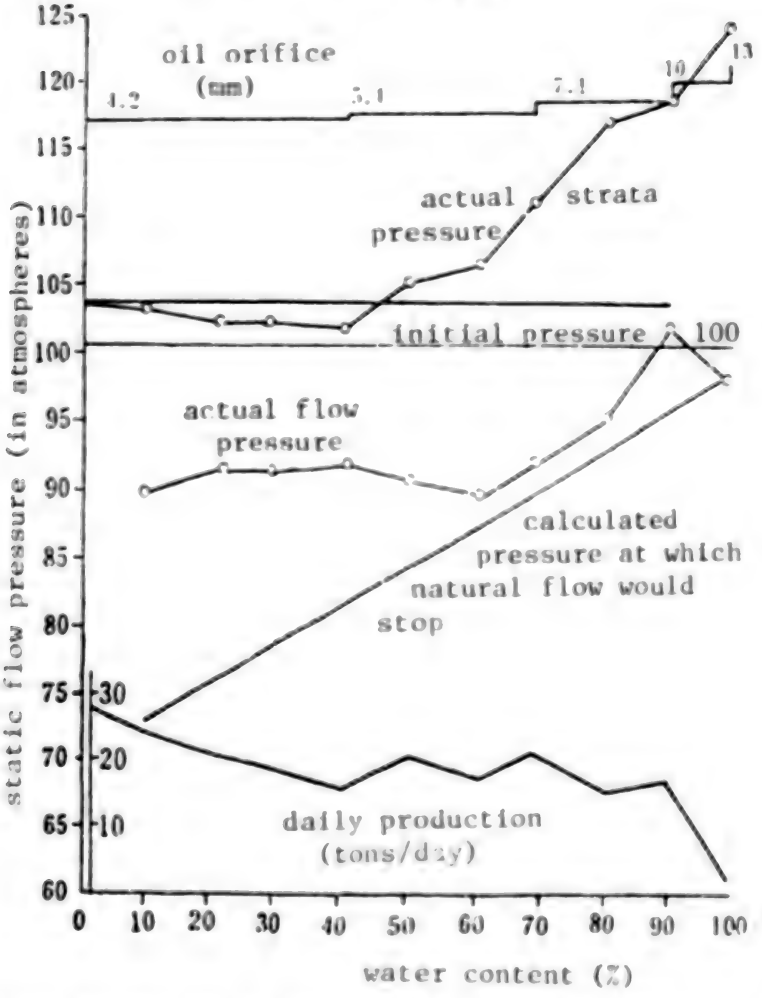
Key:

1. Theoretical value for the PU stratum
2. Theoretical value for the SA stratum
3. Well 501 SA $II_{7+8}$
4. Well 511 PU $I_{4-7}$
5. Thick stratum PU $I_2$




According to the above analysis, after entering into the high water-cut period, production potential drops off, and peak production is difficult to maintain using existing natural flow methods in the wells. If we use methods to raise reservoir pressure to increase the production pressure and keep production from dropping, then according to our calculations, when water content reaches 75 percent, reservoir pressure must be elevated 20 to 30 atmospheres above the initial pressure (Figure 2), and this is not a reasonable thing to do in oil field development. Thus if during high water-cut periods we wish to raise oil well liquid production potential to effect peak production, we must change to an exploitation methods that lower well bottom flow pressure.

Figure 2. Graph of fluctuation in flow pressure with changes in water content in close-spaced well 511 Sa $II_{7+8}$




B. Difficulties Brought on by Continuing To Raise Reservoir Pressure After Entering the High Water-Cut Period

Since entering into the high water-cut period, the Daqing oil field has proven through the last 3 years' experience that numerous problems are brought on by using methods of raising reservoir pressure to maintain steady production.

1. Interstrata interference will be made more severe

Those oil strata with a high permeability coefficient already have a large area of high water contnet, and if pressure is further elevated, this will necessarily intensify interference with other strata with relatively lower coefficients of permeability, reducing the thickness of oil yield (Figure 3).

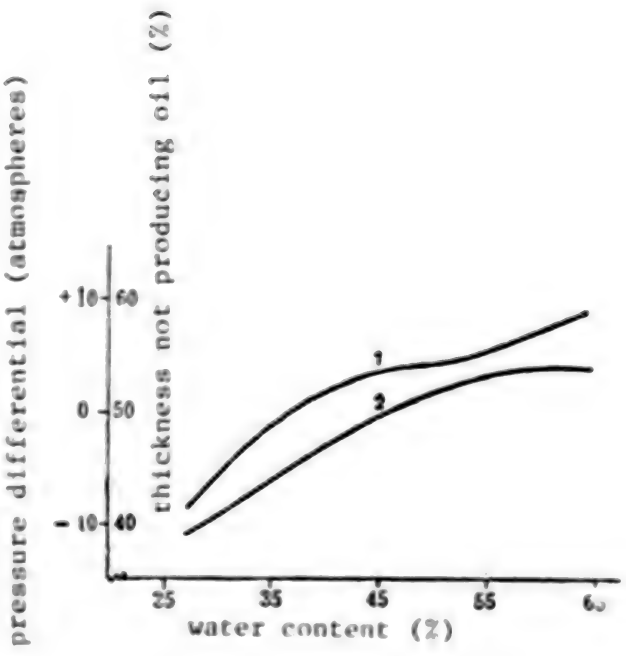
2. Environmental damage to oil and water cell casings is accelerated

After the pressure induced by water injection rises higher than the bursting pressure of the stratum, water enters into mudstone sections and fault faces,

Figure 3. Reference graph from the Xing Bei area showing that pressure differential is not enough to overcome the relationship between water content and the thickness of the non-producing part of the stratum.

Key:

1. Non-producing thickness
2. Pressure differential (atmospheres)




the mudstone expands, and this causes creep and fault slip motion, taking the well casing out of alignment, with very serious consequences.

3. The oil-bearing zone is pushed up into the gas cap and down beyond the bottom oil boundary

If the pressure in the oil strata becomes excessive, it forces the crude oil into the gas cap and the boundary, causing losses of accumulation. According to data gathered from an observation well into the gas interface surface of the gas cap of the Lamadian oil field, the gas-oil interface surface was elevated in three wells, one as high as 1.6 m, and a migration along the plane surface of about 36 m; occurred in the transition zone of the north and east of the Sa area, oil was forced below the bottom boundary filling gaps in the mixed oil and water zone and the water zone, the phenomenon of the oil migrating away was also observed.

4. Relocation of wells and well drilling techniques are made fairly complicated

The relocation of wells in old oil areas is one of the most important measures to be effected for peak production in high water-cut periods. But if the reservoir pressure is too high, it makes well drilling complicated. The specific gravity of the well drilling mud must be greater than 1.6, and sometimes as much as 2.0 and above. High density mud makes for irregularities in electric log data, it pollutes the oil strata, and slows down drilling; well quality is definitely influenced.

In short, when reservoir pressure is excessive and injected water pressure is excessive, great difficulties are created for oil field exploitation.

C. Measures to exploit potential become more difficult and their effectiveness decreases

During exploitation of an oil field prior to entering into the middle and high water-cut period, those readjustment and control measures selected, such as readjusting water injection to divide the strata on the plane and between the strata, constantly making up pressure losses to increase production, using a variety of techniques inside one well including dividing strata by blocking water and pressurizing crevices, reducing interstrata interference, etc, ensure peak production during the pre- high-cut periods, making up for the oil field's production losses.

By the time the oil field enters the high water-cut period, there is water in most wells, and the water content is above 60 percent in more than half of them. According to figures from the Sa and Pu oil strata in the Sa Zhong area, water is found at 60 percent of the thickness, and high water content accounts for one third of that. The effect of water injection wells to readjust the interstrata surfaces becomes weaker and weaker. The effect of pressurizing crevices is also weakened due to strata with a high permeability coefficient being turned into strata with a low permeability coefficient, the production potential dropping, and interference from high water content strata added in on top of that. According to figures from pressurized wells in one time period, on average the single well could produce an extra 26 tons, while in the 60 to 80 percent water content period it could only produce an extra 6 tons, and in the 80 to 90 percent period it could only produce an extra 3 tons. The effective period is also very short, and in wells with a high water content production basically could not be increased after the water in the well was blocked off. At the same time, because one well may be producing from a fair number of reservoir strata, interstrata pressurization and water-cut conditions may be fairly complex, and one well may be repeatedly taking measures to find water, block off water, pressurize, etc. The work is difficult and the economic benefits are lacking. Yet, as the water content goes up, the margin of production loss naturally becomes greater over time, and if only the above measures are relied upon, it will not be long before they are unable to make up for the natural decrease of production in old wells.

II. Possibility and Feasibility of Continued Peak Production During High Water-Cut Periods

The oil field entered the high water-cut period 3 years ago and the present overall water content is close to 70 percent, taking up 25 percent of the geological storage capacity. By changing measures in a timely manner, continuing to work on the basics of strata separation by water injection, drilling a great number of exploratory wells to increase the level of known reserves, pumping out old wells and increasing work on pressurizing oil wells the production losses of the wells have been made up for in a way suited to the requirements of the high water-cut period. More important is that the experience of working under high water-cut conditions has been gained, increasing our faith that the oil field can stay in peak production now and in the future.

A. A Definite Amount of Exploitable Reserves Exist, which May Supply Some Readjustments to Exploitation

While going through the low and middle water-cut period, as well as during the last 3 years' work under high water-cut conditions, we have improved our understanding of the potential reserves of the oil field and of the capabilities for technological exploitation. The latest accounting of geologic reserves is much greater than the original accounting and recoverable reserves are now much greater than the original calculations, and this is the material basis for continued peak production.

Daqing oil has a fairly high viscosity, over 50 percent of the exploitable reserves is to be taken out under high water-cut conditions. It can be seen from the entire experience of the close spaced wells and the experimental thick strata single reservoir water drive area that when water content is 60 percent the average oil taken out is only 46.5 percent of the recoverable reserve, and when water content is 70 percent, an average of 54 percent of the recoverable reserve is taken out (see Table 1).

Table 1. Recovery index data from the close-spaced, well-thick strata experimental zone in the high water-cut phase.

| | | Recovery of recoverable reserve (%) | | | |
|---|---|---|---|---|---|
| | Water content (%) | 60 | 70 | 80 | 90 |
| Well, strata | 511, Sa $II_{7+8}$ | 38.4 | 47.1 | 60.8 | 79.5 |
| | 501, Sa $II_{7+8}$ | 45.1 | 54.1 | 65.4 | 79.1 |
| | 501, Pu $I_{1-2}$ | 45.2 | 53.6 | 63.6 | 79.3 |
| | 511, Pu $I_{4-7}$ | 55.4 | 59.8 | 66.9 | 80.6 |
| | Experimental thick strata zone | 48.6 | 55.4 | 65.5 | 79.8 |
| | Average | 46.5 | 54.0 | 64.4 | 79.6 |

Now, in every small zone with high water-cut the intersection of the curves for the amount of accumulated liquid production and amount of water produced versus the replacement action caused by oil exploitation is used to calculate the maximum recoverable reserve, with results similar in the closely spaced wells and in the thick strata experiments (Table 2). For all other zones in the oil field with water content already exceeding 70 percent, the method will produce similar results.

Table 2. Data on recovery index in small zone high water-cut phase.

| Area | East part of Sa nan, transition zone | | | West part of Sa zhong | | | Gaotaizi stratum, north block, Sa zhong | | |
|---|---|---|---|---|---|---|---|---|---|
| Well spacing (m) | 300 | | | 600, 300 | | | 150 | | |
| Overall water content (%) | 60 | 70 | 80 | 60 | 70 | 80 | 60 | 70 | 80 |
| Recovery of recoverable reserve (%) | 41.45 | 51.6 | 66.36 | 43.7 | 54.37 | 68.03 | 47.77 | 57.25 | 65.42 |

Because oil strata are thick and numerous in the Daqing oil field and anisotropy is fairly severe between strata, the original spacing of wells and dividing up of strata was too crude, the well spacing was inappropriate to the oil strata with a low coefficient of permeability. As a result, "fill in" wells were drilled in the old area, with oil-deficient strata as their object, and whether by effecting fine analysis of strata systems or by effecting closer spacing of wells, the increase in the effect of water drive action and in lessening interstrata interference was pronounced and in general the recoverable reserves were increased by about 20 percent. The completion of wells with new spacing over the last 2 years has amply explained that they are the most important measure at present to make up the losses in well production. When the "fill in" wells went into production they ensured that the oil field would continue with peak production, and they caused the rate of rise of water content over the entire oil field to be reduced 2 percent. According to plan, if wells are respaced closer once in the entire old area, the density of well spacing will be more than doubled, and a single new well will have an average production capacity of 2/3 to 1/3 that of an old well, with low water content, a fairly long period of peak production, and as they are built and put into production according to plan over the years they will guarantee peak production in the oil field over a fairly long period.

B. The possibility of increasing liquid production through rotary pumping of wells

The oil field, after entering into the high water-cut period, must speed up its increase of liquid production to a much higher rate than in the middle water-cut period as the water content increases. When water content is 70 percent the liquid-to-oil ratio is 3.33, when water content is 85 percent the ratio is 6.67, and when water content is 90 percent the ratio reaches 10. A prerequisite for peak production during the high water-cut period is the ability to speed up increases in liquid production to meet to demands of rising water content. The liquid producing capability of high water-cut an oil well is related mainly to such variable as its liquid production index in other than high water-cut times, production pressure and thickness being exploited (number of wells).

1. Liquid production index: When the curve of the relationship between the liquid production index calculated from the curves of similar permeability rates with the proportion of water content is compared to curves from field experience, their shapes are quite different before the middle water-cut period, but when water content goes above 70 percent the rate of increase of the liquid production index becomes closer as the water content increases (Figure 1). Taking the liquid production index at 70 percent water content as a starting figure, the ratio of the theoretical figure to the liquid production index (at 70 percent) is as follows: Pu strata, 1.21; Sa strata, 1.21; actual data from the Pu $I_2$ thick strata is 1.19; well 501 Sa $II_{7+8}$ is 1.37. When water content is 95 percent the theoretical values are 1.29 and 1.58 while the actual data is 1.26 and 1.57. Thus if the average value of the data from the experimental zone is used for predictions when the water content goes above 70 percent, different ranges in increase of the liquid production index during the water-cut period are possible.

2. Production pressure losses: When the strata pressure cannot lift over any distance, we are able only to change to a different means of production, using long-range well bottom pressurization to increase production pressure. Since the

strata pressures in the Daqing oil field have been maintained at about the initial pressure to enable natural flow production, when a well uses rotary pumping the pressure at the bottom of that well often falls below saturation pressure, and we are forced to consider the problem of three phase permeability that occurs in the oil strata. Its first effect is to make pumping irregular, as the gas-to-liquid ratio at the pump entrance cannot exceed the load specifications for the pump, but the size of the gas-to-liquid ratio is related to the flow and saturation pressures and the proportion of water content. So it is possible to calculate the lowest limit of flow pressure for different areas with different saturation pressure and different water content according to the capability of the pump for the appropriate gas to liquid ratio. The overall water content at Daqing oil field is now 70 percent, and about 75 percent of the wells still employ natural flow production, with an average pressure differential of 23 atmospheres; after wells are changed to rotary pumping across the board, in order to preserve strata pressure in the neighborhood of the primitive pressure when water content reaches 85 percent, the greatest pressure differential can be raised to 70 atmospheres; when water content is 90 percent it can be 76 atmospheres, 3 and 3.3 times respectively times present production pressure differentials.

3. Production losses after drop in flow pressure:

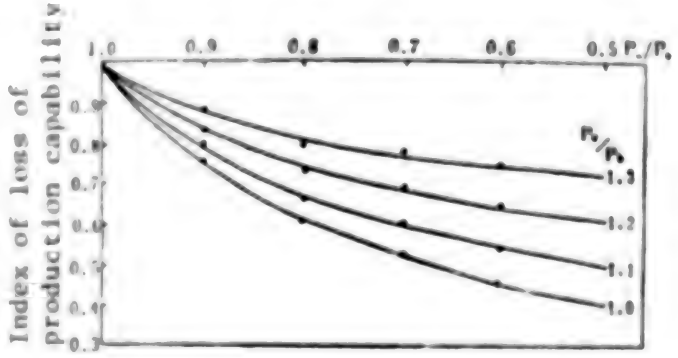
Since the pressure at the bottom of the well often falls below saturation pressure, and we are also forced to consider the problem of three phase permeability as it affects the oil well's production. As can be seen from examining the curves for the index of drop-off of production capability shown by the strata pressure/saturation pressure ratio and flow pressure/saturation pressure ratio calculated from actual field data, at the lowest flow pressure, corresponding to water content of 85 to 90 percent, the well's index of production capability drop-off will be 58 and 51 percent at the time the flow pressure equals the saturation pressure (Figure 4).

Figure 4. Graph of decline in oil recovery index (with water content above 60 percent) in Sa zhong.

$P_w$---flow pressure (atmospheres)

$P_e$---strata pressure (atmospheres)

$P_b$---saturation pressure (atmospheres)




4. The production thickness (number of wells) variable: We consider that in the high water-cut period (water content 85 to 90 percent), the production thickness of wells with particularly high water content such as those on strata Guan and Ka should be reduced by 10 to 15 percent.

To summarize the above four points (Table 3), when water content is 85 percent, the maximum liquid production can be two times that of the present, and to maintain peak production the liquid production would best increase by a multiple of two, so the liquid production potential can meet the requirements of increased water content. But when water content is 90 percent, the calculated liquid production figure is only 2.19 that of the present, and at this time peak production demands an increase of three times the liquid production figure. It can be seen that increased liquid production potential will not meet the demands of increased water content.

Table 3. Analysis of possibility for peak production during high water-cut phase

| Overall water content (%) | | 70 | 85 | 90 |
|---|---|---|---|---|
| 70 % | Average liquid production index (tons/day • atmospheres) | 1 | 1.33 | 1.42 |
| | Average production pressure (atmospheres) | 1 | 3 | 3.3 |
| | Index of decline in production capability (tons/day • atmospheres) | 1 | 0.58 | 0.51 |
| | Thickness exploited (meters) | 1 | 0.9 | 0.85 |
| | Liquid production capability (tons/day) | 1 | 2 | 2.19 |
| Liquid/oil ratio | | 3.33 | 6.67 | 10 |
| Peak production possible? | | | yes | no |

As can be seen, under ideal conditions the bottom limit for liquid production for a rotary pump well to maintain oil production is 85 percent water content (and in actuality it is somewhat lower).

From this analysis of increased liquid production of newly respaced wells and oil wells pumped out with rotary pumps, it is completely possible for Daqing oil field to maintain a fairly long term, peak production.

III. Summary

Loss of oil well productivity is a natural consequence of high water-cut periods, continuing natural flow exploitation cannot by itself effect peak production.

In attempting to counter loss of well productivity, it is not suitable to increase strata pressure on a wide scale in an attempt to effect peak production. The water injection pressure may not exceed the vertical rock pressure of the cap layer at the perforation section.

From an analysis of present conditions in the oil field, peak production can be continued after entering into the high water-cut period, but the important measures for peak production, excluding the continued attempt at overall revision of technique with water injection as its foundation, are the necessary closer spacing of wells and the conversion of old wells from natural flow to rotary pumping, to increase liquid production on a large scale.

The liquid production capability stemming from rotary pumping of natural flow wells will be enough to meet the requirements of maintaining peak production by increasing liquid production until water content reaches 85 percent; after exceeding this limit, it cannot effect peak production.

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CSO: 4013/205

## NATIONAL GAS EXPLORATION CORPORATION SET UP

OW242106 Beijing XINHUA in English 1438 GMT 24 Sep 84

[Text] Beijing, 24 Sep (XINHUA)--China has set up a national corporation to supervise the country's natural gas exploration and development work, Yan Dunshi, a top Chinese petrogeologist said here today at the closing session of the Beijing Petroleum Geology Symposium.

Based on studies over several years, Yan and his Chinese colleagues have made preliminary estimates that China's potential onshore and offshore petroleum resources come to about 66 billion tons and the potential natural gas resources to about 20,000 to 25,000 billion cubic meters, a broad area for oil and gas exploration activities.

But, they pointed out, on China's 5.45 million square kilometers of oil and gas-bearing sedimentary rock area, only one exploratory well has been drilled for every 230 square kilometers.

The United States has about the same area of sedimentary rock as China, they added, but about a dozen exploratory wells have been drilled for every square kilometer.

They also noted that China's natural gas industry is in the early stage of development. Many important theoretical and practical questions remain to be studied and solved in oil and gas exploration and development.

Yan Dunshi said that there are often cases in which the actual amount of oil pumped out is greater than what is forecast by conventional means. This calls for efforts to explain the reason with regard to oil generation theory, he said.

The Tarim Basin in northwest China is the country's largest basin of sedimentary rock and physical surveys in recent years have shown that the sediment there is about 25 kilometers thick.

Michel T. Halbouty, a noted American petrogeologist, said that China's most promising region for oil and gas is the northwest.

Guided by the country's new open policy, Yan said, Chinese petrogeologists will increase cooperation with their foreign counterparts in studying

important issues concerning petrogeology. He suggested that more symposiums like this should be held in the coming years.

Weng Wenbo, 72, a geology division member of the Chinese Academy of Sciences and chief engineer of the Institute for Petroleum Exploration and Development, said that China's oil industry will reach its peak after the present world oil production goes into decline.

Weng Wenbo, who graduated from Qinghua University in 1934 and studied at Imperial College, London, from 1936 to 1939, said: "The prime of the country's gas industry will come much later than that of the oil industry. At present, China's gas industry is a rising one, just like the morning sun."

CSO: 4010/7

OIL AND GAS

XINJIANG TO EXPLOIT NEW OIL-GAS FIELD, BUILD REFINERY

Urumqi Xinjiang Regional Service In Mandarin 1300 GMT 25 Sep 84

[Text] With the approval of the State Council, our region will formally exploit the (Kekeya) oil and gas field and at the same time will build the (Depu) Petrochemical Plant. Exploiting the Kekeya oil and gas field and building the Depu Petrochemical Plant are key projects which the state will help Xinjiang build during the Seventh 5-Year Plan period.

Last August, when Premier Zhao Ziyang was inspecting our region, in light of the extremely short supply of petroleum products, chemical fertilizers, and fuel for civil use in the southwestern part of southern Xinjiang, including Kashi, Hotan, and Kizilsu Kirgiz Autonomous Prefecture, he gave important instructions on exploiting the Kekeya oil and gas resources and building a chemical fertilizer plant and an oil refinery to support local economic construction.

In view of this, Kang Shien, state councillor, went to south Xinjiang to conduct a large-scale investigation and put forward specific suggestions. The State Planning Commission very quickly included the exploitation of the Kekeya oil and gas field and the building of the Depu petrochemical plant in the 1984 state plan for key capital construction projects. After the Ministry of Petroleum Industry, the Ministry of Chemical Industry, the China Petrochemical Corporation, and departments concerned of the region made concerted efforts, the program for the exploitation and the design of the Kekeya oil and gas field have now been completed, the site for the Depu Petrochemical Plant has been selected, the report on the feasibility of this work has been adopted, the plan has been formulated, and the steps for the projects have been determined. It has been decided to complete the preliminary stage of work in the first half of next year.

After the Depu Petrochemical Plant is completed, it will be able to process 150,000 tons of crude oil a year, and at the same time produce 60,000 tons of synthetic ammonia and 10,000 tons of liquefied petroleum gas. The Kekeya oil and gas field will provide crude oil to this plant. After the completion of these two projects, they will play an important part in promoting industrial and agricultural production in southern Xinjiang.

CSO: 4013/14

OIL AND GAS

## BP-LED CONSORTIUM FINDS OIL IN SOUTHERN YELLOW SEA

Beijing XINHUA in English 1207 GMT 27 Sep 84

[Text] Beijing, 27 Sep (XINHUA)--Oil has been tapped in an exploratory well by a consortium led by British Petroleum Development Ltd [BP] in the South Yellow Sea, the China National Offshore Oil corporation [CNOOC] announced here this afternoon.

The success proved that there are good oil-generation and entrapping conditions in the continental shelf of the South Yellow Sea, though nine exploratory wells drilled earlier proved dry, CNOOC stressed. Hence, broad prospects remain there for oil and gas finds, it added.

Drilling operation of the 3,907-meter-deep well, Changzhou 6-1-1, started on 15 April and was completed on September 3.

The operation was undertaken by the "Bohai No. 10" drilling vessel of CNOOC's Bohai Petroleum corporation.

CSO: 4010/6

OIL AND GAS

SURVEY EXPECTED TO FIND MORE HEILONGJIANG RESERVES

Beijing XINHUA in English 1037 GMT 27 Sep 84

[Text] Harbin, 26 Sep (XINHUA)--More than 20,000 workers are now surveying nine areas in northeast China expecting to find oil-bearing structures of considerable industrial valued.

Of the 14 drilling teams, two are American. There are also five seismic surveying teams operating in the Qijiaoxian area, a down-warped region near Daqing, China's leading oilfield in Heilongjiang Province.

Up to the present, 14 exploratory wells have been drilled in the area and all have reported oil and gas shows.

Oil reserves totalling 70 million tons are expected to be verified over 100 square kilometers in the area by the end of the year. The figure is believed to be one-fifth of the total reserves in the nine areas so far ascertainable.

Daqing will be able to produce more than 53 million tons of crude oil by the end of December, up from last year's 52.23 million tons and rising from ninth place to sixth in the world.

The 5,000-sq km oilfield has pumped 712 million tons since it began operation in 1960--more than 50 percent of the country's total for the 24-year period.

It has also generated 64.3 billion yuan (about 25.7 billion U.S. dollars) in taxes and profits for the state--19.1 times the state investment in the oilfield.

It has ensured a high and stable output over the past 24 years by adopting new oil production techniques and upgrading production equipment.

In addition, more than 100,000 skilled workers, technicians and managerial staff members have been transferred from Daqing to spread their expertise among other oilfields.

CSO: 4010/6

## 'WENCHANG 19-1-2' BEGINS TO PUMP OIL IN PEARL RIVER BASIN

OW171128 Beijing XINHUA in English 1048 GMT 17 Sep 84

[Text] Beijing, 17 Sep (XINHUA)--A well producing 429 tons of crude oil a day has been drilled in the Pearl River Mouth Basin of the South China Sea, the China National Offshore Oil Corporation (CNOOC) announced here this afternoon.

This is the first oil ever struck in the Pearl River Mouth Basin. "This latest break-through is very inspiring," CNOOC said.

The well, Wenchang 19-1-2, is in the contract area (40/01) awarded to an ESSO-led consortium and the drilling was done by ESSO-China limited of the United States and the Nanhai Western Petroleum Corporation of CNOOC.

The discovery of the structure, Wenchang 19-1, is important for the area, CNOOC geologists said, adding that there are large numbers of promising structures around it. "We believe that with the on-going exploration, more oil reserves will be discovered," they said.

The Wenchang 19-1-2 well is 120 km east of Hainan Island and is in a water depth of 126 meters.

Drilling of the 3,331-meter deep well by the drilling vessel "Jim Cunningham" began on 4 June this year, and was completed on 29 July.

Further drilling is needed to determine the commercial value of the latest discovery, according to ESSO and CNOOC.

Therefore, the drilling vessel will remain on the spot to undertake the drilling of a third exploratory well.

In April this year, the first well on the same structure was drilled and a small amount of oil flow was reported.

The ESSO-led consortium which won the right to search for oil in the area signed a contract with CNOOC on 23 August last year.

CSO: 4010/146

## NATION'S CRUDE OIL OUTPUT HITS ALL-TIME HIGH

OW210229 Beijing XINHUA in English 1913 GMT 20 Sep 84

[Text] Beijing, 20 Sep (XINHUA)--Oil industry Vice-Minister Li Tianxiang told foreign and Chinese petro-geologists today that China's crude oil output this year would top 110 million tons, hitting an all-time high.

The vice-minister disclosed this figure at the opening session of a 6-day petroleum geology symposium here this morning when he was giving a briefing on the country's oil industry.

He told the 156 Chinese and foreign petrogeologists that in developing oil-fields, China has effectively controlled the decline in production output and has ensured a steady rise year by year.

An inspiring situation prevails in China's oil and gas exploration, Li said, adding that new breakthroughs have been made in the exploration of compound oil and gas reservoirs and of thrust fault zones, thus increasing the scope for searching for oil and gas.

In the 1981-83 period, Li recalled, China verified 1.06 billion tons of on-shore oil reserves, and in 1983 alone the figure was 570 million tons.

He stressed that the priority in China's oil industry in the coming years is to increase known reserves and strive to pump out 150 million tons of crude oil by the year 1990.

Li also added that in the past three decades and more, China has discovered and put into operation more than 200 oil and gas fields, and has developed 16 oil-gas producing bases. China's annual oil output has topped 100 million tons for 6 consecutive years.

Oil and natural gas are the primary sources of energy in the world today, the Chinese vice-minister said, and the discovery of more oil resources draws worldwide attention.

China is a country endowed with rich oil resources, the vice-minister said. Chinese petro-geologists will join their foreign counterparts in developing new concepts and techniques in oil exploration so as to boost China's oil industry.

Addressing the opening session, State Councillor Kan Shi'en extended his congratulations on the symposium and said that new discoveries have been made in both oil zones and new exploration areas in China, an illustration that the country's oil industry has entered a new stage of development.

To develop this excellent situation further, Kang said, China "very much needs, and is willing to increase cooperation and exchanges with, foreign petro-geological organizations."

Voicing his hopes for the future of China's petroleum industry, Michel T. Halbouty, honorary chairman of the symposium and a well-known American petro-geologist, said at the opening session, that he would like to predict that given the same degree of effort and determination in future years as shown over the past 2 years, China will continue to advance to the top five oil and gas-producing nations of the world.

China produced 106 million tons of crude oil in 1983, ranking the seventh-largest oil producer in the world.

Participants in the symposium, which is cosponsored by the China National Oil and Gas Exploration and Development Corporation and the Circumpacific Council for Energy and Mineral Resources, will present 60 papers on new concepts, new frontiers and new methods in petroleum geological prospecting in the 1980's.

CSO: 4010/146

OIL AND GAS

## VAST TRACTS OF POTENTIAL OIL-BEARING STRATA STILL UNEXPLORED

OW210205 Beijing XINHUA in English 1904 GMT 20 Sep 84

[Text] Beijing, 20 Sep (XINHUA)--China has 5.45 million square kilometers of sedimentary rock with potential oil and gas deposits, more than 50 percent of the country's total territory, a top Chinese petro-geologist said here this afternoon.

In his paper "Characteristics of Sedimentary Basins in China and Their Oil and Gas Distribution," Zhai Guangming told Chinese and foreign colleagues here for the Beijing Petroleum Geology Symposium that very limited exploration has been done in China's sedimentary basins, averaging only one exploratory well every 230 square kilometers of sedimentary rock. Detailed exploration has been carried out in just 13 percent of the total area of the land sedimentary basins, and exploration has just begun on 20 percent of the total. "No exploration has been done so far on the two-thirds of the country's total area of sedimentary rock," Zhai Guangming said.

The United States has about the same area of sedimentary rock as China, he said, but about a dozen exploratory wells have been drilled on every square kilometer of that area.

China's oil and gas bearing areas can be divided into four parts, the eastern, western and central parts of the country and the continental shelf. Covering about 600,000 square kilometers, the eastern part is now China's major crude oil producing base and the region pumps out more than 90 percent of the country's total yearly crude oil output.

The western part covers more than one million square kilometers and is currently being prepared for exploration and development.

The central area covers about 2 million square kilometers including Sichuan Province, China's largest natural gas producer. More than 60 of the over 80 oil and gas fields discovered are natural gas fields.

The last area is the continental shelf. China has 1.3 million square kilometers of offshore continental shelf less than 200 meters deep. Since 1979, a general seismic survey has been conducted in part of the Bohai Sea and parts of the Chinese sectors of the South Yellow Sea and the South China Sea, which

has discovered various types of structure. Preliminary drilling by some Sino-foreign teams show that industrial discoveries have been made in more than 10 oil-gas bearing structures and more than 20 wells producing a daily average of over 100 tons of crude oil have been drilled.

These results show that China has favorable geological conditions for large discoveries and has great potential in the search for oil. Zhai predicts that China's offshore area will become another major crude oil producer.

Zhai called marine sediments the major area remaining for oil exploration in the world today. In China, he said, there are 1.9 million square kilometers of marine sediments, on which no detailed exploration has been conducted. Exploration has just begun in the western sedimentary basins and the continental shelf, where large oil and gas discoveries are possible.

"Therefore," he concluded, "great potential remains for oil and gas exploration in China."

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## UPGRADING OF OLD WELLS HELPS BOOST SHENGLI PRODUCTION

OW210553 Beijing XINHUA in English 1500 GMT 20 Sep 84

[Text] Jinan, 20 September (XINHUA)--The Shengli oilfield, China's second-largest, produced 14.3 million tons of crude oil in the first 8 months of this year, 19 percent more than the period of last year, according to oil industry officials.

At the same time, 7,050 kilometers of seismic lines were host, up 104.3 percent, and drilling footages reached more than 1.3 million meters, up 82 percent. In addition, new wells were drilled for an additional production capacity of 1.31 million tons.

Technical upgrading of the old wells contributed much to the increased production. New technologies employed in the oilfield include high-pressure drilling and hydraulic piston pumping.

Shengli's daily output of crude oil averaged 65,080 tons in August this year, as against 53,500 tons in December last year, an official stated.

Moreover, new breakthroughs were made in oil exploration during the period, which led to the discovery of large oil reserves in presinian granite gneiss, one of the oldest rock formations, believed to be oil-poor, and in reef lime [word indistinct] of the cenzoic era, one of the most productive oil-bearing strata known in the world [words indistinct].

The 20-year-old oilfield, opened up on coastal sand, plans to catch up with the country's largest oilfield--Daqing--by 1989. Last year it pumped out 18.36 million tons of crude oil.

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## BRIEFS

SHENGLI 20-YEAR OUTPUT--Over the past 20 years, the Shengli Oilfield in Shandong Province produced a total of 220 million tons of crude oil, and the profits and taxes delivered by the oilfield to the state were five times that of the state's investments. By the end of this August, the oilfield had drilled a total of 7,000 oil wells; tunneled 15 million meters of footage; produced 220 million tons of crude oil and 13.2 billion cubic meters of natural gas; created 2.56 million yuan of industrial output value; and handed over 13.6 billion yuan in profits and taxes to the state. This August, the average daily output of crude oil was 12,000 tons more than that in December last year. [Summary] [Jinan Shandong Provincial Service in Mandarin 2300 GMT 15 Sep 84 SK]

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